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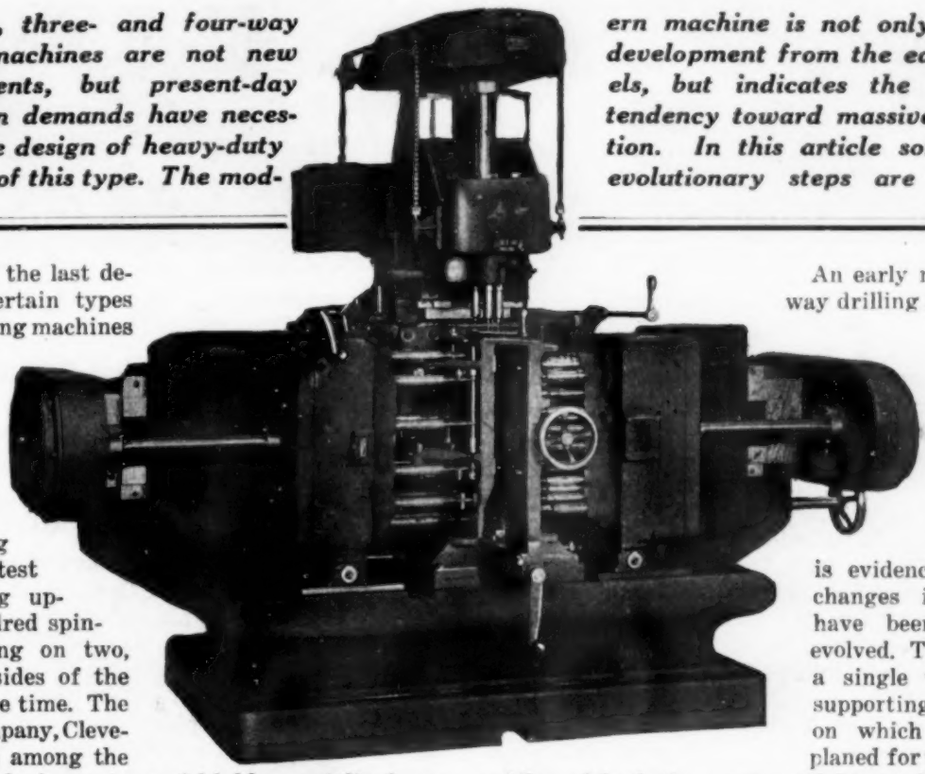
The Foote-Burt "Way" Drilling Machines

"A Study in the Evolution of Machine Design"

By J. V. HUNTER, Western Editor, *American Machinist*

The two-, three- and four-way drilling machines are not new developments, but present-day production demands have necessitated the design of heavy-duty machines of this type. The modern machine is not only a logical development from the earlier models, but indicates the increasing tendency toward massive construction. In this article some of the evolutionary steps are indicated.



WITHIN the last decade certain types of drilling machines have been developed from the single-spindle machine on through single-unit multiple-drilling heads, to the latest models carrying upward of a hundred spindles and drilling on two, three or four sides of the work at the same time. The Foote-Burt Company, Cleveland, Ohio, was among the pioneers in developing a type of highly specialized machines, which are today sometimes called "Way" drilling machines.

An early model of a four-way drilling machine is illustrated in Fig. 1. This machine was shipped from the factory in July, 1910, and a comparison of it with later models is evidence of the great changes in design that have been gradually evolved. This machine had a single vertical column supporting the work jig on which ways were planed for the travel of the saddles of both the upper and inverted drilling heads. The side heads were carried by comparatively light wing brackets bolted to each side of the column, which gave

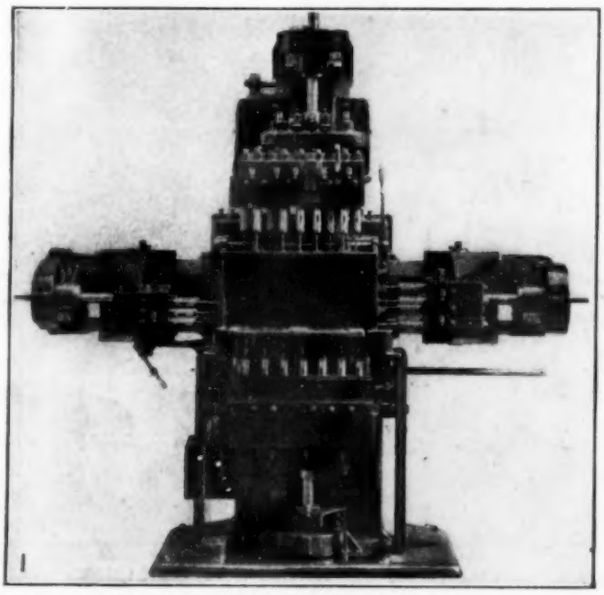


FIG. 1. EARLY TYPE FOUR-WAY DRILLING MACHINE

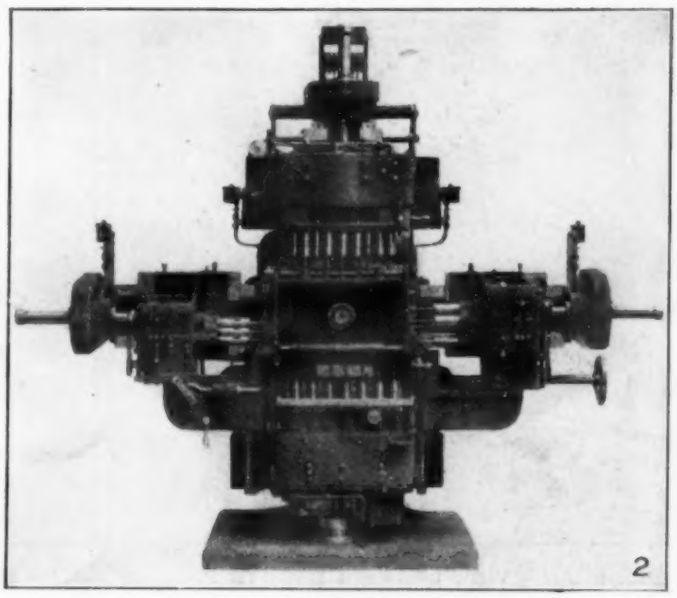


FIG. 2. DRILLING MACHINE BUILT IN 1912

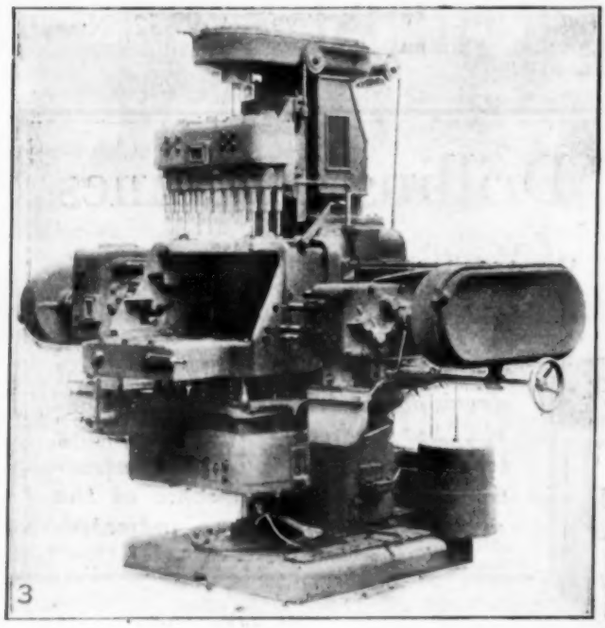


FIG. 3. LATER MODEL SHOWING REFINEMENTS OF DESIGN

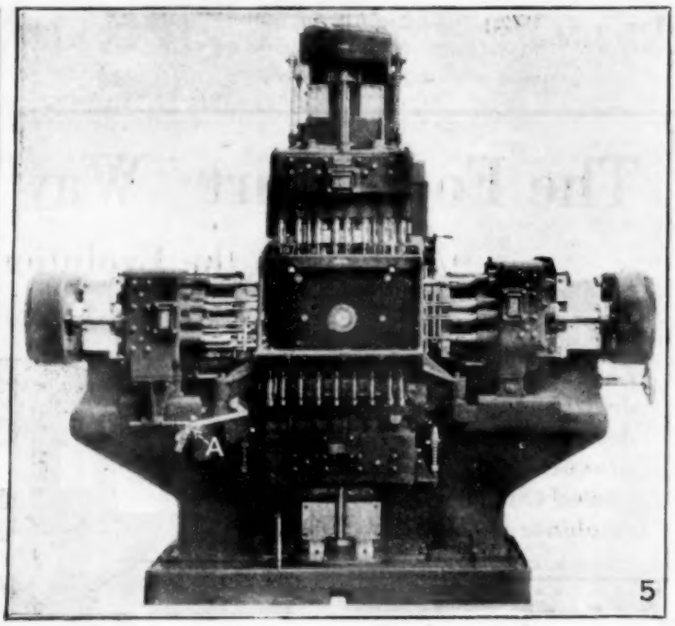


FIG. 5. LATEST MODEL OF FOUR-WAY DRILLING MACHINE

the machine a somewhat spidery appearance. Numerous oil cups show prominently on all of the bracket bearings, and oil-level indicators showed the height of the oil in the upper and lower spindle-head compartments, which were the only portions of the machine designed to run in an oil bath.

During the year 1912-13 other machines, of a design shown in Fig. 2, were built for the same job, which shows that new ideas developed as the result of experience with the earlier models. The spindle-head bearing saddles were widened and carried on supplementary slides to permit compensatory adjustment for the wear and regrinding of the drills. The bracket slides for the side heads were more heavily constructed and were supported by supplementary brackets extending from the column. These brackets also served to support the forward corners of the work jig. The many individual oil cups were supplanted by gang sight-feed oilers with feed pipes to the various bearings.

Flooded lubrication from separate pumps was provided for each spindle head. Each pump was belted to a pulley on an extension of one of the spindle shafts. This arrangement furnished a constant flow of oil while the spindles were in motion.

A year or two later the re-design, Fig. 3, shows relatively little change in the general structure of the machine, but extensive alterations were made affecting many of the minor details. One of the outstanding features developed was a provision to avoid the troubles caused by chips and dirt which worked into the bearings of the inverted spindle head. This improvement was an elaboration of a method more simply applied on earlier models.

This head is now protected at the top by a sloping

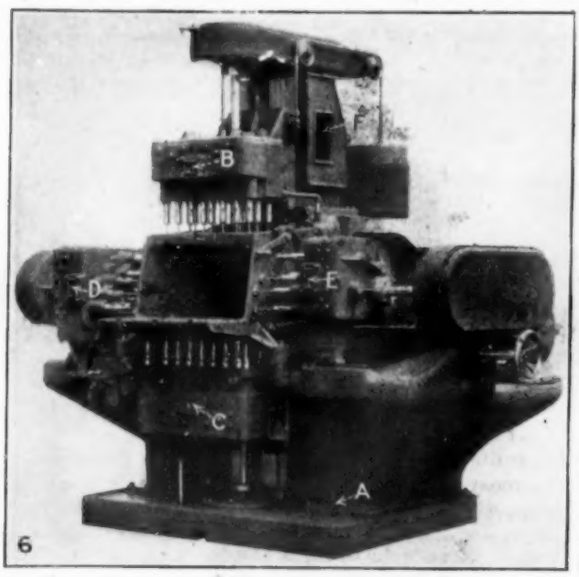


FIG. 6. SIDE VIEW SHOWING MASSIVE FORM OF CONSTRUCTION

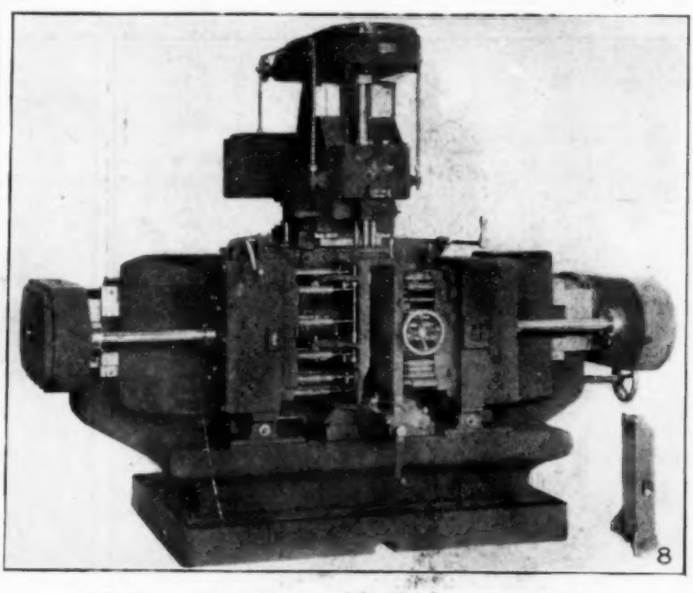


FIG. 8 LATE MODEL OF THREE-WAY DRILLING MACHINE

shield *A*, Fig. 4, which tightly surrounds the spindle and prevents the accumulation of chips.

Below the shield are two plates, *B* and *C*, spaced a fraction of an inch apart where they surround the spindles and bolted together with an airtight flange around the outer edges. At each end of these plates is an air hose connection; from one of these a blast of air can

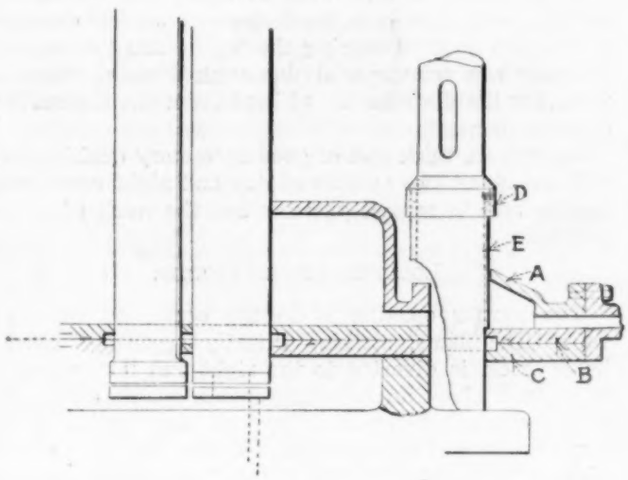


FIG. 4. CHIP PROTECTION DEVICE USED ON INVERTED HEAD

be blown, the exhaust taking place through the other, and all fine dust which enters this space is blown out, thus preventing its reaching the inner bearings. In addition to this each spindle is surrounded by a tapered cone *D*, which fits over a stationary sleeve *E* that extends through the top shield to the plate *B*. The sleeve *E* is stationary so no wear occurs between it and the shield.

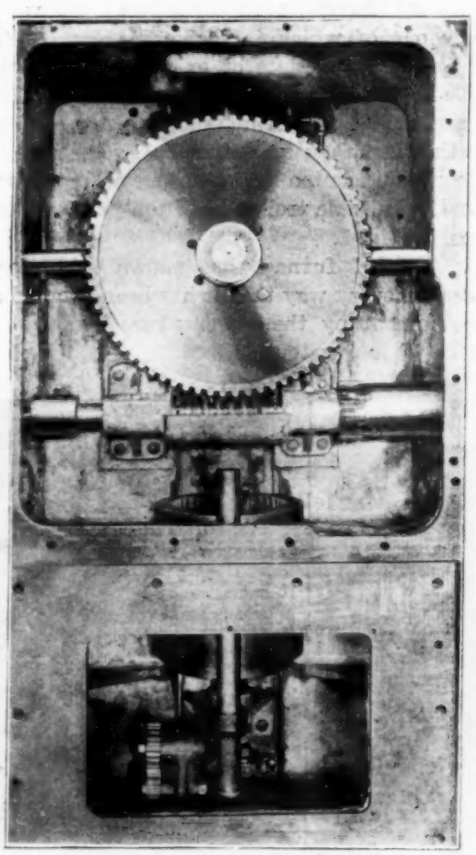


FIG. 7. DRIVE GEARING FOR FEED MECHANISM OF SIDE SPINDLES

The more recent developments have resulted in a machine of heavier design as illustrated in Fig. 5. The base is wide and heavy, supporting a full-width column of such proportions that the side arms formerly used are obviously not required. Longer saddles are supplied with wide bearing faces on the ways. A great change is to be marked in the oiling system, that is planned to be as nearly fool-proof as possible.

A single oil pump in the base handles practically the entire oiling. This draws from a reservoir indicated by the gage *A*, Fig. 6, and by a complete system of distribution provides lubrication for all moving parts, including even the head slides. The spindle heads are given flood lubrication and the operator can observe the circulation through small glass-covered windows *B* and *C* in the upper and lower heads, and *D* and *E* in the side heads. In the main vertical column a larger window *F* serves the same purpose for all the gearing and other parts in that compartment. Suitable pipes are provided where necessary to return the oil to the reservoir.

In the earliest models the main drive shafts of the spindle heads were fast in the head and passed through a sliding-key gear in the housing, which necessitated the undesirable outboard shaft extensions shown in Fig. 2. This has now been altered and one end of the shaft is supported in the drive-gear case while the other end slides in the spindle-head housing.

Control Levers That Automatically Reverse the Feed to Draw Out the Drills

The control levers *A*, Fig. 5, automatically reverse the feed to draw out the drills rapidly on the completion of their cut. The feed mechanism for the side spindles is driven by an arrangement of gearing inclosed in the main column. A view of this with its cover plates removed is shown in Fig. 7.

One of the latest machines carries 61 active spindles. It has been timed for a drilling period of 1 min. 45 sec. A 25-hp. direct-current motor drives the main shaft by a 6-in. Link-Belt chain. The motor is mounted at the rear on a heavy cast-iron pedestal which is bolted to both the main body and the base casting. The floor space requirements of the machine are 9 ft. 7½ in. long by 8 ft. 3½ in. wide, the total height being 8 ft. 9½ in.

The development of the three-way drilling machine has closely followed its four-way prototype with the same general features as may be seen from Fig. 8. This machine was built for drilling the automobile engine oil pan shown standing at the right. Although simplified by the absence of the inverted spindle head, the heavy structure with its extensions for the side spindle heads shows the substantial design of the machine.

Indirect-Fired Cyanide Furnace

By W. H. Addis

The economically upkeep of the cyanide furnace is one of the most troublesome factors with which heat-treating departments have to deal. Where such furnaces are run 24 hr. a day they must possess a very nice combination of qualities in order to be practical.

One of the most expensive faults of the average furnace equipment is the ever-recurring shutdowns due to

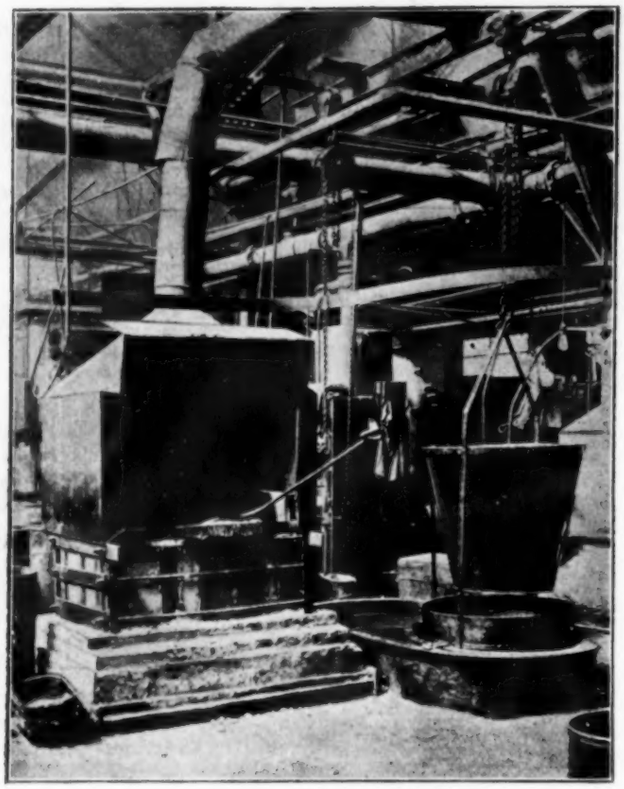


FIG. 1. THE CYANIDE FURNACE

the burning out of pots, but this fault is being overcome to some degree by the recent advent of the cast-steel pot of special composition, and the still more recent pots of nickel-chromium alloy.

Yet, with these improved containers on the market, the day is not past when great quantities of cast-iron pots are in use, and in most types of such furnaces there is direct contact of the burner flame with the pot. This has seemed necessary because the cyanide furnace requires a very flexible heat control that will enable the operator to raise the temperature of his bath very rapidly to counteract the chilling effect when cold work is entered in the melted salts. If this chilled condition is not quickly overcome by forced firing there will be a marked degree of variation in the finished product, especially if the parts be small and the desired case very light.

In the indirect-fired furnace shown in Fig. 1, the following conditions are met: flexible burner control; indirect firing with consequent pot protection from wasting flame action; low fuel consumption; low initial expense; ease of repair and low maintenance costs.

As may be seen in the engraving, this furnace is almost entirely of standard firebrick construction. The floor, or base, is laid with firebrick and refractory cement, and upon it is built the combustion chamber shown in Fig. 2. Covering the top of this rectangular chamber are four special flue-brick forming flues or ports for the distribution of heat from the combustion chamber beneath.

Being 8 in. thick and of good refractory quality, they will last about two months of day and night continuous service and to replace them is but the work of a few moments.

Location of the Burner

The burner opening is in the center of the back wall. The flame, striking directly against a central baffle brick, is diverted to the right and left, where it is in turn given an infolding movement at either end of the combustion chamber by two baffle bricks at the front corners of the chamber. A clean-out door is provided at either side of the burner port, which provides for the removal of all cyanide that might drip down into the combustion chamber when the pot burns out.

The rectangular side walls are formed by using firebrick slabs 4 in. thick upon the top edges of which the front and back flanges of the cast-steel pots rest.

The Pots and Forks

It might be interesting to describe the pots, sometimes called baskets, used for holding the work in the cyanide, one of which is shown in Fig. 3. They are made by sawing a piece of extra-heavy steel pipe into suitable lengths and welding in the bottoms after which they are drilled to permit the escape of cyanide into the bath when they are lifted out. As these pots and their contents are too heavy to be comfortably managed by hand, a suitable trolley has been provided which will be seen in Fig. 1.

This type of furnace has shown such decided advantages in every way that it has been adopted as standard equipment by the plant where the first one was designed by the writer.

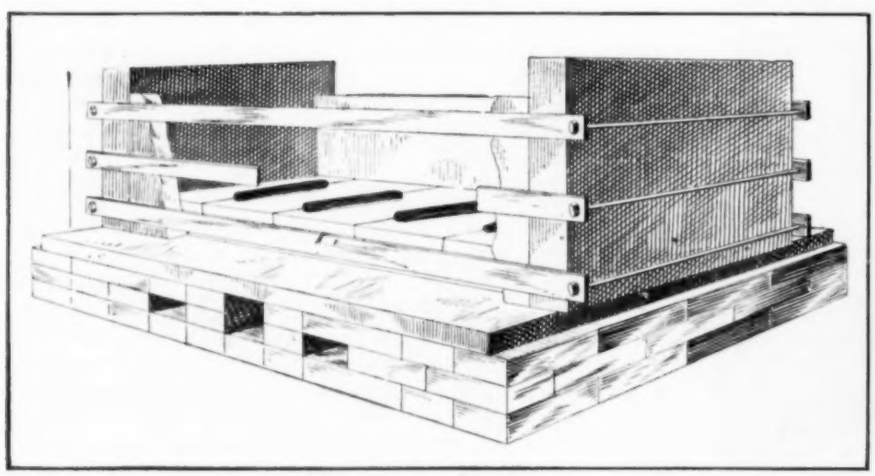


FIG. 2. CONSTRUCTION OF FURNACE

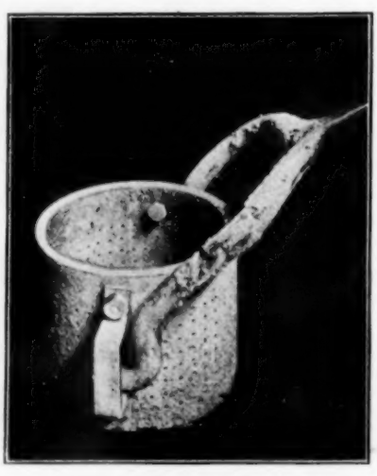


FIG. 3. DIPPING "BASKET"

Hardening Steel Without Distortion

BY FRED. H. COLVIN
Editor, *American Machinist*

What would it mean to your shop and to the country at large, if all hardening could be done without distortion or breakage? How much could be saved if we could avoid the necessity of correcting errors due to hardening? Herein is described a method which enables the hardener to determine definitely the proper instant for quenching each piece to be hardened.

WE HAVE become so accustomed to the element of uncertainty in connection with the hardening of steel that we deliberately allow for a certain amount of distortion in such small tools as taps and dies, and we also accept a certain percentage of loss from cracks as being a necessary part of the process. Whenever we happen to secure perfect results we are more apt to consider it an act of Providence than the result of correct hardening conditions. But as every effect has its cause, so must there be causes for good, bad and indifferent results in hardening steel; and it has evidently been the privilege of the Leeds & Northrup Company to discover some of the causes and to devise apparatus to enable the expert hardener to secure results which he has heretofore deemed impossible of attainment. For it must be distinctly understood that the apparatus and the method to be described will not enable the novice to do expert work. On the contrary, it only makes it possible for the good man to do better work than ever before and to secure results which he had heretofore considered impossible.

The development of this method dates back several years, during which time it has been tried out in various ways and new facts discovered as time went on. The critical point of steel has long been studied and the endeavor has been to use the pyrometer to determine whether the furnace reached the proper heat for the kind of steel being treated.

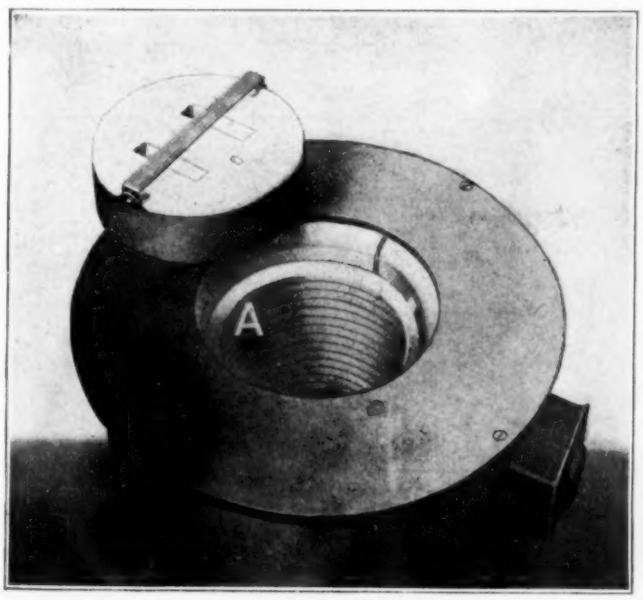


FIG. 1. A VIEW INTO THE FURNACE

Careful experiments, extending over a long period and with practical results always in mind, have shown that the hump in a pyrometer record of a piece of steel may easily vary from 30 to 40 deg. F. in accordance with the rate at which it is heated. For example, a piece of steel heated at the rate of 15 deg. per minute may appear to reach its critical point at 1370 deg. F., while the same piece of steel, heated at the rate of 40 deg. per minute, will not seem to reach its critical point until about 1400 deg. F.

This does not mean that the actual critical point of the steel on the heated side is affected by the heating rate, for in the vast majority of steels at least, this is

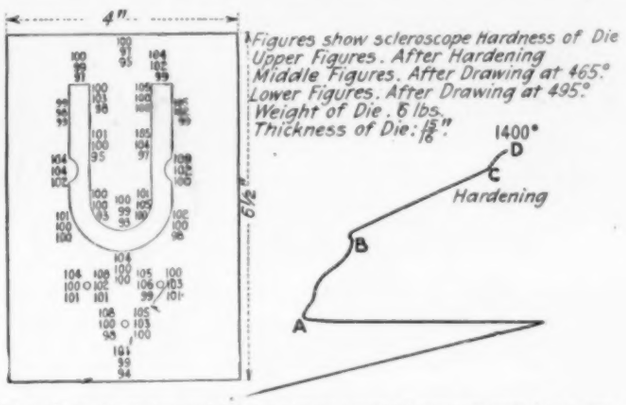


FIG. 2. DIAGRAM OF DIE AND HARDENING TEMPERATURE

not the case. The vital point is that the apparent temperature of the critical point has no bearing on the successful operation of the process.

The cause of the variation of the "hump" on the record is that the thermocouple does not, while the steel is rising in temperature, measure the true temperature of the steel itself at any given instant. The couple is outside of the steel, in contact with it or nearly in contact, but it is also acted upon by the air of the furnace and subject to the direct action of the heat radiated from the furnace walls. Consequently, the thermocouple, at any given instant, indicates on the record a temperature that is neither of the steel nor of the furnace itself, but is a mean between the two.

If the steel is heating rapidly there will be a greater difference between the steel and the furnace than when the heating rate is slow. Consequently, the thermocouple at any given instant, when the steel is heating rapidly, will indicate a higher temperature than would be the case were the steel heating slowly. Hence, on the record, the "hump" will occur at a higher point on the temperature scale than would be the case were the steel heating more slowly, and while the apparent critical point would be higher, the actual critical range is unchanged. The crucial thing is that, regardless of the heating rate, the time at which the steel passes through the critical range is infallibly indicated by the record.

This discovery, together with the fact that steel heated in the proper way and quenched at exactly the proper point can be hardened without distortion, pointed out the necessity of some heating method in which the rate of increase could be definitely controlled. This led

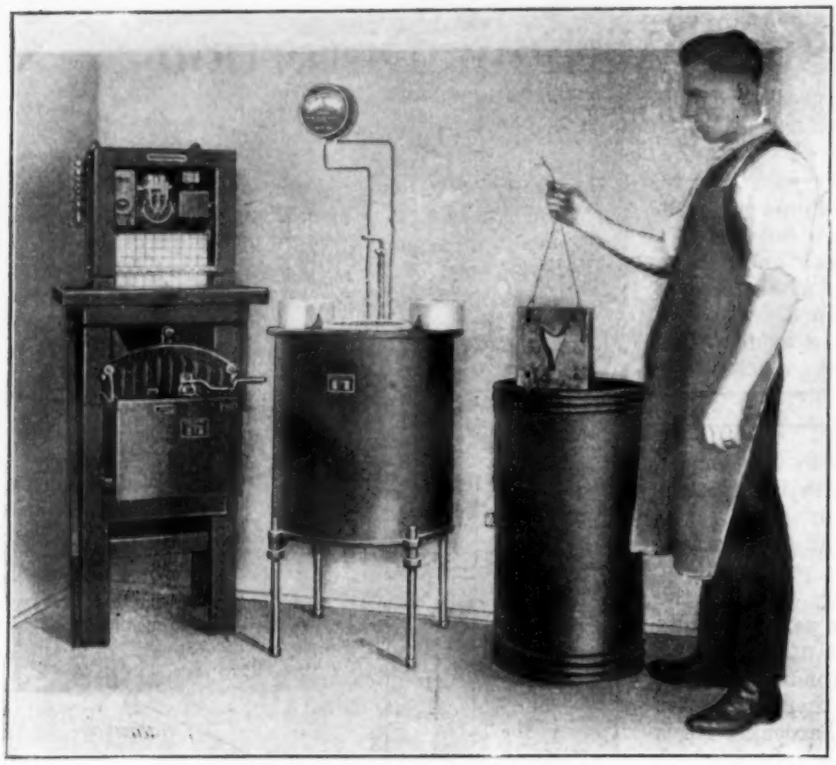


FIG. 2. THE HARDENING UNIT

to the adoption of the electric furnace shown in Fig. 1, while Fig. 2 shows how it is coupled up with the rheostat and the recording pyrometer, which makes a complete unit.

The heating element of the furnace is the thin cylinder shown at *A*, Fig. 1, which contains the resistance wire embedded in a special non-conductor. The wires are quite near the inner surface so as to require as little current as possible to secure the necessary heat, while the cylinder itself is surrounded by heavy segments of insulation as can be seen. The combination keeps practically all the heat inside the inner cylinder, and one of the surprising features of the furnace is the fact that the cover remains cool enough to be easily handled without gloves.

Fig. 2 shows the complete hardening outfit, including the quenching tank, with a die which has just been quenched. The diagram shown in Fig. 3 is the record of the heating of the die shown in outline in the left of the cut. This die is $\frac{15}{16}$ in. thick, 4 in. wide, and $6\frac{1}{2}$ in. long, and weighs 6 lb. The hardening process is as follows:

The temperature of the furnace is brought up to between 1300 and 1400 deg. F. and the current shut off. The die is then suspended vertically in the furnace so that the lower edge rests on a thermocouple connected with the recorder shown on the stand in Fig. 2. The heat record of the piece begins at *A*, Fig. 3, and it will be seen that the temperature line increases fairly regularly up to *B*. As soon as the work and the furnace reach the same temperature, current is again switched on, preferably at a rate which will give an increase of about 20 deg. per minute, this having been found most satisfactory for carbon steel.

The diagram shows that the furnace had begun to cool very slightly before current was turned on, this being indicated by the small loop at *B*. From this point the temperature rises uniformly to *C*, where the steel enters the critical period. Watching the change here very closely, the piece was removed from the furnace when it reached the point *D*, this temperature happening to be 1400. The exact temperature in degrees, however, is not important, the quenching point being determined by the critical period in the particular piece of steel being hardened, regardless of the exact temperature which this may show on the Fahrenheit or other scale.

After hardening, the die was drawn twice, first at 465 and later at 495 deg. F. The three sets of figures on the die block show the scleroscope hardness at the various points, the upper figures being after hardening, the middle figures after the first drawing and the lower figures after drawing at 495 deg. F. The uniformity is quite remarkable, but not so much so as the fact that this method of hardening retains the die in its original shape to such an extent that no stoning is necessary before putting it into use. This is all the more remarkable when we consider that the die is quenched in brine, which is usually considered a very severe shock in hardening tools of this kind.

Fig. 4 shows a punch and die made by this method some time ago, and, as can be seen from the water marks still on the die, the surface of this has never been ground since the first hardening. The die was hardened by this method and retained its shape to such a degree that absolutely no grinding or stoning was necessary to make it fit the punch perfectly. In fact, it still cuts tissue paper, although it has in the meantime been used in punching metal disks.

That this is not simply an accident is indicated by the fact that over 800 punches and dies have been hardened by this method, and in no case has it been necessary to stone or in otherwise fit the die and punch together. This seems to indicate that the reason for distortion has been discovered, as well as means for overcoming it.

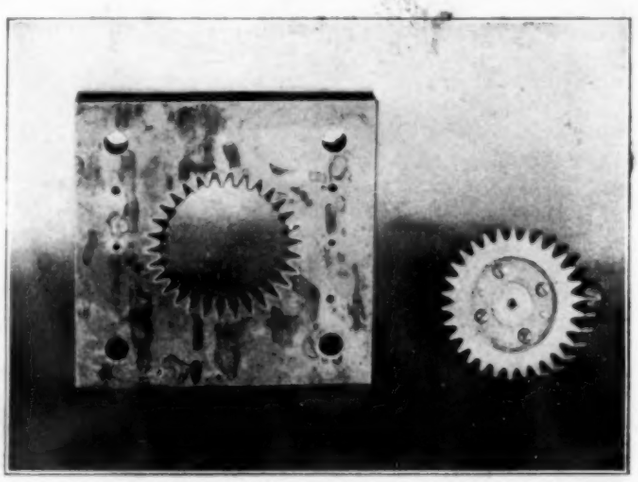


FIG. 4. A TYPICAL PUNCH AND DIE

One of the interesting features of the punches and dies, and which proves conclusively the practical side of the process, is the way in which the die is made from the punch. The punch is first made to the desired size and hardened. The die is then cut out and shaped fairly close to the finished size. It is then broached out with

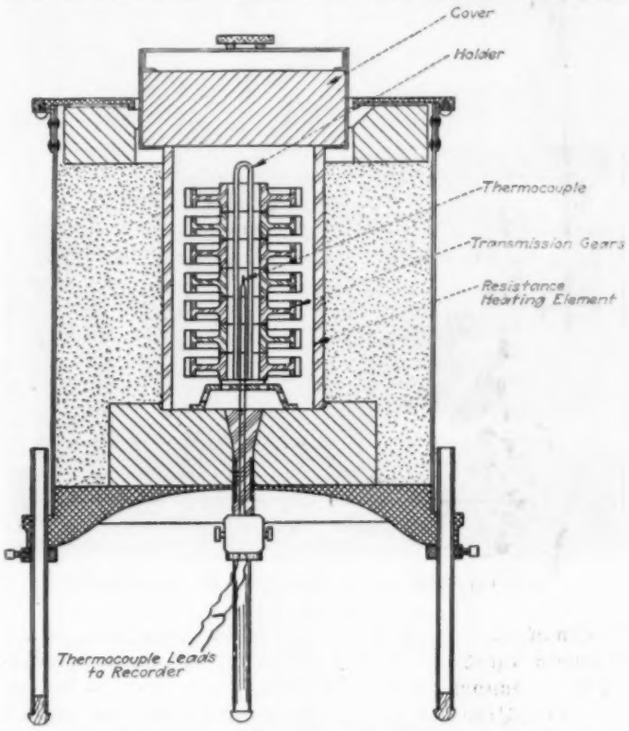


FIG. 5. FURNACE FOR AUTOMOBILE GEARS

the punch which has already been hardened and the die is then hardened in the same way as the punch. This method of hardening holds the die sufficiently close to the shape made by the punch as to avoid the necessity of stoning, which is the almost universal custom.

The use of this method has not been confined to the Leeds & Northrup Company plant, but it is now being used by high-grade automobile manufacturers for hardening gears so as to prevent the distortion which necessitated the grinding of the piece in order to secure perfect gears and quiet running. The furnaces for this work are shown in section in Fig. 5.

This illustration shows how the gears are held, the location of the thermocouple and the general arrangement. In Fig. 6 is a production record indicating the regularity with which the furnaces are heated, the uniform rate of heating obtained and the continuity of the whole process. No time was lost and the regularity of the 45-min. interval is remarkable. It is also interesting to note that, in spite of the higher cost of heating by electric current when the total cost of the product is considered, the balance is found to be on the right side of the ledger by a very wide margin.

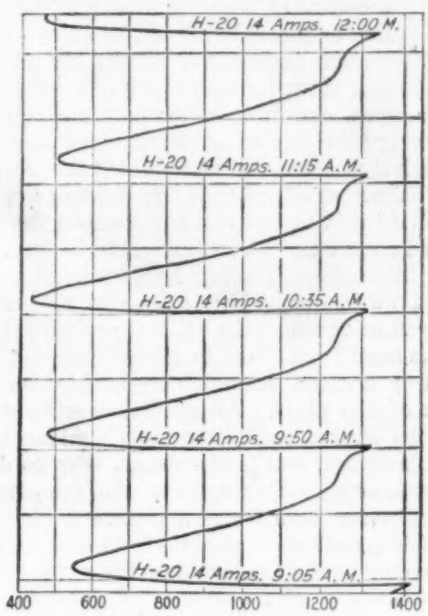


FIG. 6. A RECORD FROM A PRODUCTION FURNACE

Perhaps the greatest difficulty of introducing a sys-

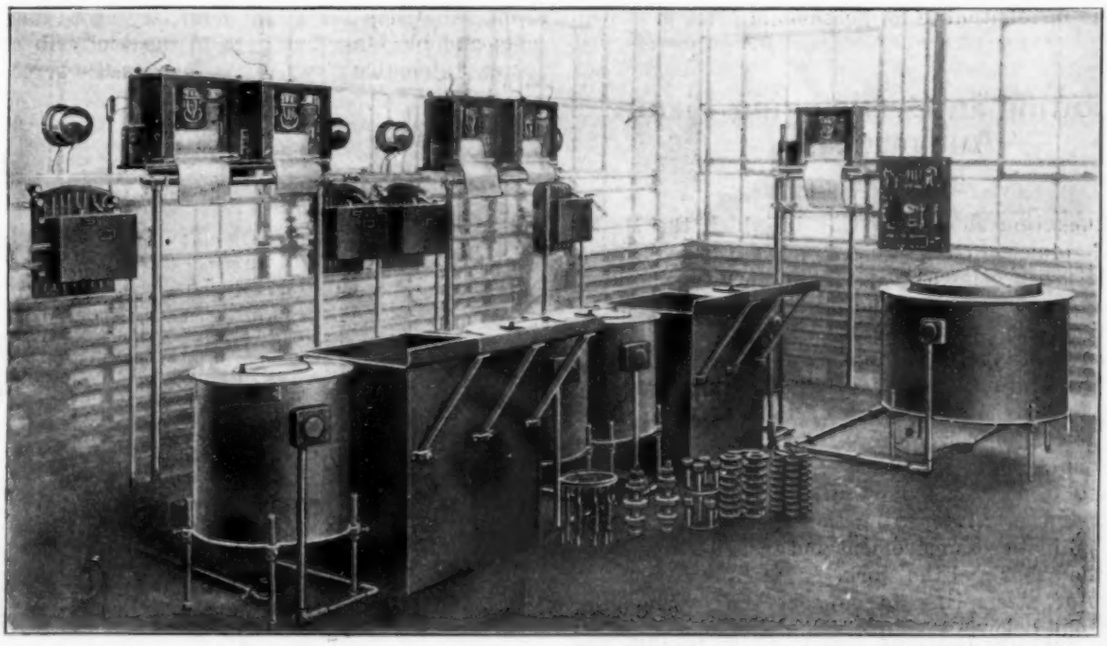


FIG. 7. AN AUTOMOBILE-PLANT INSTALLATION

tem of this kind lies in securing men with the proper training who will appreciate the assistance of such a device and who can make use of it to the fullest extent. Experience alone will enable them to secure best results as the best quenching point will vary with the size of the work and possibly with the kind of steel being handled.

With such a method of knowing exactly what is taking place in the piece or pieces being hardened, the hardener can learn to secure exactly the results he desires and can depend upon securing uniformity. For, unlike the dependence upon obtaining a given temperature, this method disregards the exact number of degrees but shows positively the exact time at which the work passes into the critical period, so that the hardener can watch for the end of this period and can remove the work at such a time as his experience shows to be best for the particular kind of work being hardened.

On small work, quenching is done at or just before the piece passes through the critical period. On larger work it has been found best to allow it to pass through the period by a given amount, depending upon the size and shape of the piece. All special treatment of this kind must be worked out by the individual hardener for his particular work, and is the reason why no device of this kind can, or should, attempt to take the place of the highest skill obtainable for this work.

With such a method of control it is easy to conceive of the possibility of so controlling the time of quenching as to secure a given amount of distortion, either enlarging or shrinking, should such a change be necessary in order to reclaim work a little over or under size. This is in keeping with the old practice of enlarging pins or shafts intended for force fits by a series of heatings and coolings, which has been practised by blacksmiths for many years. This, however, provides an exact method of accomplishing this should it be necessary. The main advantage of the system, however, is that tools or other work can be hardened with the certainty of retaining their exact dimensions and of avoiding the losses due to cracking, which has heretofore been considered a necessary evil in connection with the hardening and treating of steel.

A recent installation in an automobile plant is shown in Fig. 7.

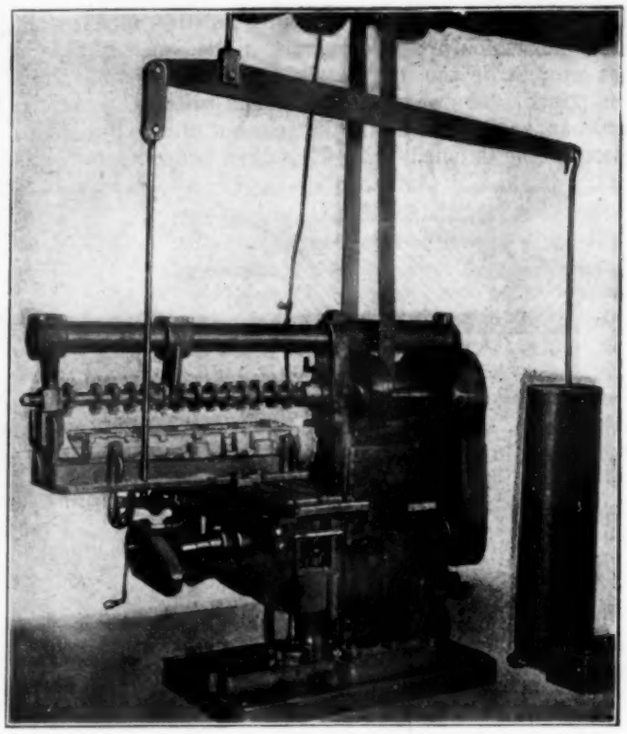
Supporting an Overhanging Fixture Automatically

By I. B. Rich

The illustration shows the way in which the H. H. Franklin Manufacturing Co., Syracuse, N. Y., was enabled to use a comparatively light knee-type milling machine for a job which would otherwise have required a much more expensive machine.

The operation is milling the ends of the main bearing seats of the aluminum crank case shown, this requiring a milling arbor the full length of the crank case and carrying 14 coarse-tooth cutters. An extension overarm supports the arbor at the outer end, and also near the center, and it will be noted the outer arm guides the outer end of the fixture, tying the arm and the fixture together against cross movement and insuring the alignment of the arbor and the work.

Instead of attempting to support the overhanging weight from below, a simple but ingenious counterweight was devised, which not only takes care of the overhang at a fixed point but allows the knee to be adjusted vertically to any desired position, and maintains its support in all positions. The work is fed up to the cutters, and the counterweight takes the desired proportion of the load in all positions.

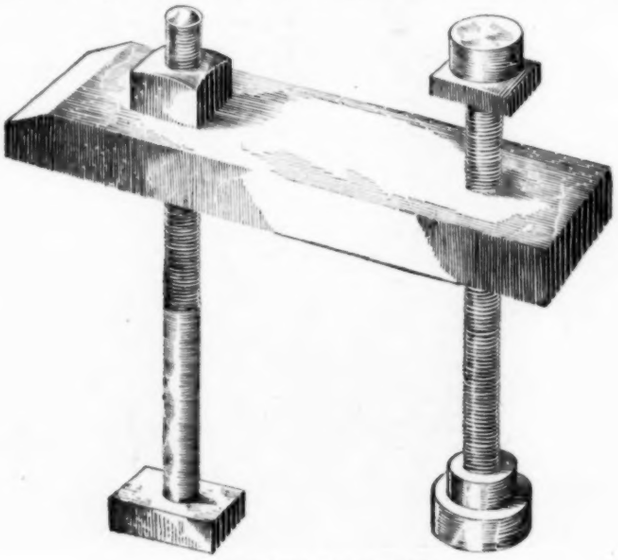


SUPPORTING AN OVERHANGING FIXTURE

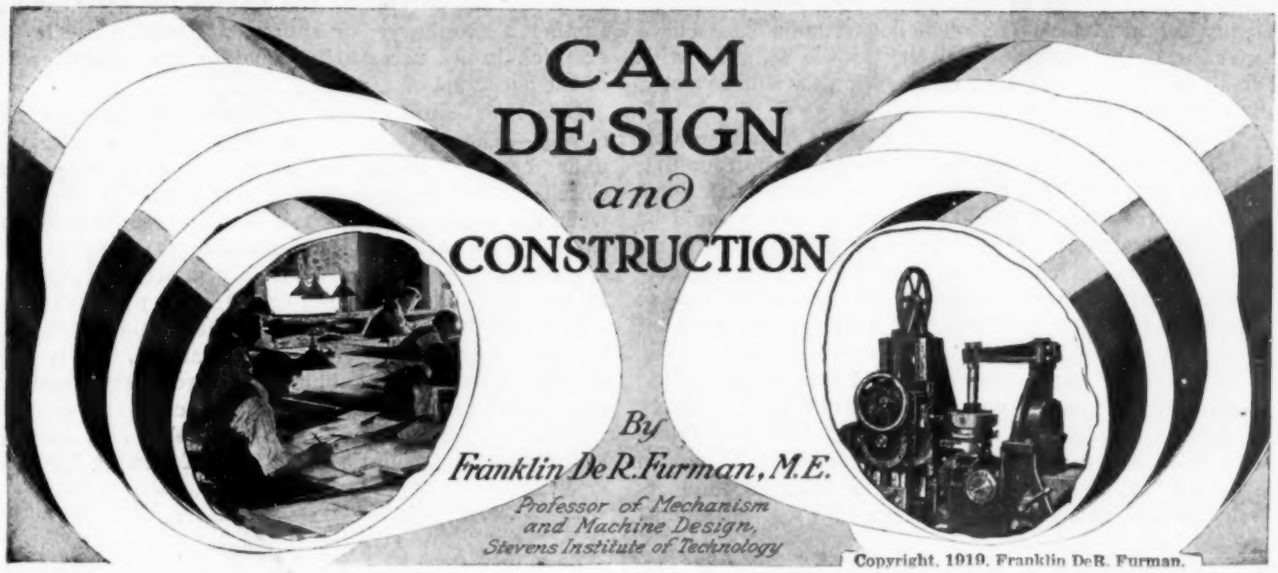
An Adjustable Strap

By Joseph C. Fisher

The sketch shows an adjustable strap or clamp which can be used to advantage on drilling, milling, and planing machines, etc., that is a great time saver in several ways; for instance, when a man gets a job to do in any one of these machines, he doesn't have to look around the shop for a half hour, trying to find straps, bolts and blocking, but goes to the tool crib and asks for an adjustable strap, when he gets the three in one.



AN ADJUSTABLE STRAP



IX. Complete List and Comparison of Base Curves

Systematic methods of cam construction for different types of fundamental base curves have been given in preceding articles. In the present issue all of the cams from these base curves are brought together to show their relative sizes for the same data. Diagrams are introduced to show the relative velocities and accelerations given by each type of cam. The methods for drawing these diagrams and for computing the cam factors which have been used throughout the series are also given in this issue.

THE base curves which have been used in the previous articles are: All-logarithmic curve, Fig. 84; logarithmic-combination curve, Fig. 88; straight line, Fig. 92; straight-line combination curve, Fig. 96; crank curve, Fig. 100; parabola curve, Fig. 104; tangential curve, case 1, Fig. 108; circular curve, case 1, Fig. 112; elliptical curve, Fig. 116; cube curve, case 1, Fig. 120; circular curve, case 2, Fig. 124; cube curve, case 2, Fig. 128, and tangential curve, case 2, Fig. 132.

Comparison of base curves, their applications and their characteristic motions.—Figs. 84 to 135 illustrate: (1) The forms of each of the base curves, column 1; (2) the form and true relative size of cam, all having the same data, column 2; (3) the velocity diagram for each cam, column 3, and (4) the acceleration diagram for each cam, column 4.

The data for all of the cams and diagrams illustrated in Figs. 84 to 135 are as follows: (a) The follower to rise 1 unit in a 60-deg. turn of the cam; (b) the follower to fall 1 unit in a 60-deg. turn of the cam; (c) the follower to remain at rest for 240-deg. turn of the cam, and (d) the maximum pressure angle to be 30 deg.

All of the cam charts illustrated in column 1, Figs. 84 to 132, include only the first item in the above data, and they show therefore only one-sixth of their full length. In column 2 the entire cam is shown in each case, and it is drawn to one-third of the scale used for the chart in column 1.

Velocity and acceleration diagrams showing characteristic action of cams having different forms of base curves.—All of the diagrams in column 3, Figs. 86 to 134, show the velocity given to the follower by the cam at every instant during the follower stroke. In each case the length of the diagram AC represents the time required by the cam to turn through 60 deg., the camshaft being assumed to be turning with uniform angular velocity. The numbered scale on each diagram shows the relative velocity given by each cam at any phase of the stroke.

All of the diagrams given in column 4 show the acceleration given to the follower by the different cams. These diagrams have a special interest when it is remembered that force = mass $\times$ acceleration, and if the mass is the same in all cases the ordinates of the diagrams represent the forces necessary to move the follower at any instant. A diagram with a distinctively long ordinate indicates that the cam will "run hard" at the phase where the long ordinate occurs. The scale numbers shown on the diagrams are based on the uniform acceleration given by the parabola cam as shown in Fig. 107.

Characteristic Actions of Cams Having Different Base Curves

The all-logarithmic curve, Fig. 84, gives the smallest possible cam for a given pressure angle. It differs from all other curves in that it gives the maximum pressure angle all the time that the follower is moving, whereas the others, with the exception of the logarithmic-combination curve, give a maximum pressure angle for an instant only. One of the disadvantages of the all-logarithmic cam is that it causes the follower to attain nearly its full velocity instantaneously and causes it to come to rest in a similar manner, thus giving a shock at the beginning and end of the stroke. This gives excessively large acceleration and retardation at the ends of the stroke and causes the cam to "pound" or "run hard" at these phases of its action. Another disadvantage is that a roller cannot be used with it because the pitch surface has a sharp edge, or angle, on the working side as shown at C, Fig. 85. The reason

why a roller cannot be used under these conditions was explained in Article III. The logarithmic base curve gives a slowly changing velocity to the follower with small and nearly constant acceleration as will be noted from Figs. 86 and 87.

Logarithmic-combination curve.—The disadvantages of the all-logarithmic cam may be overcome by rounding off the ends of the logarithmic base curve with some other useful form of arc. The arcs of circles could be used, as illustrated later in connection with the straight-line combination curve, but they would give variable acceleration to the follower at the beginning and at the end of the stroke. The best arcs for rounding off the ends of the logarithmic curve are parabolic arcs, which give uniform acceleration and retardation at the beginning and at the end of the stroke and therefore smoothest and easiest action. A logarithmic-combination base curve with parabolic end arcs is shown in Fig. 88, its corresponding cam in Fig. 89, and its velocity and acceleration diagrams in Figs. 90 and 91 respectively.

Straight base line.—The characteristics of a cam having a straight base line have already been considered in article II. A sharp or V-edge sliding follower is the only kind that can be used with the straight base line for true results; a roller cannot be used for reasons referred to in a preceding paragraph. The form of the pitch surface of the cam which is derived from the straight base line is the Archimedean spiral. The straight base line gives the smallest *simple* cam for a given maximum pressure angle.

Straight-line combination curve.—The straight-line combination base curve gives increasing velocity and acceleration at the beginning of the stroke, uniform velocity and zero acceleration during a large middle portion of the stroke, and decreasing velocity and retardation at the end. The length of the period for uniform velocity and the amounts of acceleration and retardation depend entirely on the length of the easing-off radius. This may be taken at any value. The acceleration diagram in Fig. 99 is based on a radius equal to the follower motion as shown at *BA*, Fig. 96. The shorter this radius is taken the nearer the straight-line combination curve approches the cam having a straight base line, and the action at the beginning and at the end of the stroke becomes more violent. The longer the easing off radius is taken the nearer the combination curve approaches the circular base curve of Fig. 112 and the smoother the action will be, but in this case the cam will be relatively large.

Crank curve.—The crank curve base described in article II gives increasing variable velocity during the first half of the stroke and decreasing variable velocity during the last half. The acceleration and retardation are also variable, being greatest at the ends as may be noticed by an inspection of Fig. 103.

Harmonic curve.—The crank curve is sometimes called the harmonic curve, due to the fact that it gives to the follower a motion similar to that described by the foot of a perpendicular let fall on the diameter of a crank circle from a crankpin moving with uniform velocity in that circle; or, in other words, a motion similar to that of a crosshead which is operated from a uniformly rotating crank with a T-headed or "infinite" connecting-rod. It will also be observed that the crank curve is a projection of a helix onto a plane surface parallel to the axis of the helix, and is further a sine curve, or sinusoid, in which the length or pitch is not necessarily equal to the circumference of the construction circle.

Effect of crank curve following its tangent line closely.—The crank curve has the marked characteristic, under ordinary conditions, of following its tangent so closely, as for example on each side of *E*, Fig. 100, that when the crank-curve chart is bent to form the cam, as explained in article III, a maximum pressure angle slightly greater than 30 deg. is produced in the cam. In the case illustrated in Fig. 101, the pressure angle would still be 30 deg. at *E*, but it would be 30 deg. 27 min., just to the left of *E* toward *A*. If it were desired to keep the maximum pressure angle exactly 30 deg. instead of 30 deg. 27 min. it could be done by moving all the points from *A* to *C*, Fig. 101, outward radially by the amount *d* given in the following formula:

$$d = \frac{0.5h}{\sqrt{1 + \frac{\pi^2}{b^2}\cot^2 a}},$$

where d = distance the points on the pitch surface, as obtained in the ordinary way, would have to be moved out radially to obtain exact size of crank curve cam for a given maximum pressure angle;

h = total rise of follower.

b = angle turned by cam during the follower's total rise, in radians.

If b is taken in degrees the number 180 must be used in place of π.

a = pressure angle in degrees.

The maximum pressure angle of 30 deg. would then occur where the enlarged pitch surface crosses the pitch circle which would be slightly to the left of *E*, Fig. 101. The cam would be 0.09 larger in maximum radius, or 3.19 units from *O* to *C* instead of 3.10 as shown and as used in practice.

Another way of obtaining exact results with the crank curve would be to compute the length of the chart from the following formula:

$$l = 0.5b\,h\sqrt{1 + \frac{\pi^2}{b^2}\cot^2 a}$$

For the case in hand l would equal 2.77, which it will be noticed is 0.05 larger than the practical value used in Fig. 100. With this length of chart the crank-curve base line would not reach a 30-deg. angle in the chart, but the cam pitch surface would at a point just inside of the pitch circle.

Parabola curve.—The parabola base curve, described in article III, gives uniformly increasing velocity to the follower up to mid stroke when the velocity is twice that produced by the straight base line, as illustrated in Figs. 106 and 94 respectively. The follower has uniformly decreasing velocity during the second half of its motion. Both the acceleration and the retardation are uniform throughout the stroke as shown by the horizontal lines in Fig. 107.

Perfect cam action.—The parabola is the only base curve that gives a theoretically perfect motion so far as inherent smoothness of action is concerned. It gives to the follower the same gentle motion on starting as a falling body has when starting from rest, and it brings the follower to rest at the end of its stroke with the same gentle action reversed. For this reason the curve is sometimes called the "Gravity Curve." The

curve for the parabola cam is also referred to by some as the curve of squares from the fact that the radial expansion of the curve varies as the square of the time, as may be noticed from the fact that the construction numbers 1, 4, 9 and 16 in Fig. 104 are the squares of 1, 2, 3 and 4 respectively. In Fig. 120, which will be described later, a curve is used in which the expansion of the curve varies as the cube of the time.

The parabola base curve will also operate a follower with the least amount of effort of any of the base curves, due to the fact that the acceleration is constant. In this connection actual comparative figures will be given in a later paragraph under the heading of "Comparison of Relative Velocities and Forces."

Comparison of parabola and crank base curves.—While the parabola base curve combines the two highest theoretical considerations, namely, smoothest possible motion and least power for operation, it has not become so widely used as the crank curve. This may be due to the experience of builders of cams who have found that the crank curve permits of a smaller cam for a given pressure angle than does the parabola, or for the same size cams the pressure angle is the smaller for the crank curve and therefore does not "stick" or "run hard" so much as the parabola cam of equal size. Figures on which the above statements are based may be seen in Fig. 101, where it is shown that a maximum radius of 3.10 in. is required for a lift of 1 in. in 60 deg. with a maximum pressure angle of 30 deg. when the crank curve is used, while in Fig. 105 a parabola cam is shown to require a maximum radius of 3.80 in. for the same data. The crank curve has obtained some undue comparative credit over the "parabola" curve on account of the fact that the "parabola" was constructed with spaces in some other ratio than 1, 3, 5, etc. While, for example, a true parabola may be constructed with spaces of 1, 2, 3 instead of 1, 3, 5, as used in these articles, the parabolic curve of the cam surface in the former case will not be tangent to the circular part of the cam surfaces, or, in other words, the base curve *EA* in Fig. 104 will not be tangent to the horizontal base line of the chart at *A*, but will intersect it at that point. A "parabola" cam therefore, with ordinates that are in any other ratio than 1, 4, 9, etc., will actually show "bright spots" and rapid wear at the beginning and end of the parabolic surface, and this has actually been erroneously charged against the true practical parabola cam.

A further comparison of the parabola and crank base curves shows that their velocity and acceleration lines in their maximum values, Figs. 102, 103, 106 and 107, do not differ to such an extent as to make a noticeable difference in the action in many cam applications, particularly where the smoothest motion is not essential nor where there is a surplus of driving power. Furthermore the drawing of the crank curve has appeared to some builders as a much easier and better understood procedure, and this has accounted some for the use of the crank curve. It may be observed, however, that the parabola is really no more difficult to draw than the crank curve, and when it is fully understood it is quite certain that the parabola cam will come into a more general use in all cases except where space is extremely limited, or where special considerations of the follower motion as to spring or gravity action, or as to low striking or seating velocity, etc., become especially desirable. The subjects of spring action and low striking velocities will be treated later.

Tangential base curve.—The tangential base curve differs from the others in that it cannot be directly constructed by graphical processes. The cam itself is drawn first by using straight lines as the side boundaries of the cam lobe, the straight lines being rounded off at the ends by arcs of circles or other smooth curves, as shown in Fig. 109. At the inner ends the straight lines are tangent to a circle which has the center of rotation of the cam as its center. The base curve for this cam is useful only where it is desired to find graphically the velocity and acceleration diagrams, and when it is so used it must be derived from the cam drawing.

The tangential cam for case No. 1 has a characteristic retardation curve in that it is convex downward, as shown from *F* to *H* in Fig. 111, while the retardation curves for all other cams that have intermediate maximum ordinates are either straight or concave. This characteristic may be an advantage in some cam applications and will be referred to in a later paragraph on the use of springs for returning the follower. The pressure angle factors for this curve for the data given in this problem are: 5.28 for 20 deg., 3.62 for 30 deg., 2.82 for 40 deg., 2.36 for 50 deg., and 2.09 for 60 deg. These factors are used for the ordinates of curve 9 in Fig. 136, which shows that the tangential cam, for the data of problem 19, has the advantage of smaller size over the parabola, circular, elliptical and cube cams when the lower range of pressure angles are used, but it begins rapidly to lose this advantage at angles of about 36 deg.

Further characteristics of this tangential cam that may be used to advantage in assigning data are that if the angle turned through by the cam is twice the pressure angle the maximum retardation for the circular easing-off arc of the cam will occur at the end of the stroke, as shown at *CH*, Fig. 111, and that the retardation at the point on the cam where the arc joins the straight line will be 0.866 *CH*, as shown at *EF*, Fig. 111. If the angle turned through by the cam during the motion of the follower is greater than twice the pressure angle the retardation value will still be a maximum at the end but will be less than 0.866 of this value at the point where retardation begins, that is, *EF* will be still shorter in comparion with *CH* than it is shown in Fig. 111. This condition has a practical value in that it allows a lighter-weight or smaller spring to return the follower where a spring is used. If the angle turned through by the cam during the motion of the follower is less than twice the pressure angle the retardation at *EF* will be greater than 0.866 *CH*, and if it is much less the retardation value will be a maximum at the point where the easing-off arc joins the straight line, that is, *EF* will be greater than *CH*.

Circular base curve.—The circular base curve gives variable velocity and acceleration to the follower the first half of the follower stroke and also variable velocity and retardation during the last half, as shown in Figs. 114 and 115. It will be noticed that the circular curve, Fig. 112, and the elliptical curve, Fig. 116, give nearly the same sized cams, and that the velocity and acceleration diagrams for each are quite similar.

Elliptical base curve.—The elliptical base curse gives variable velocity and variable acceleration to the follower. By using different ratios for the horizontal and

vertical axes of the ellipse on which the curve is based the velocity of the follower may be made to increase rapidly or slowly at the start and the cam may be made small or large and still not exceed a given maximum pressure angle.

Elliptical base curve, ratio 7 to 4.—As stated in the preceding paragraph the elliptical cam may be based on ellipses having various proportions between their major and minor axes. When the proportions are as 7 : 4, as in Fig. 116, where $FG = 7$, and $FC = 4$, the length of the chart will be 3.95 times the travel of the follower for a maximum pressure angle of 30 deg. The cam will be larger, but the velocity of the follower will be less at starting and stopping and greater at mid stroke than for any of the cams described thus far. If a still lower starting and stopping velocity is desired with an elliptical cam, it may be obtained by making the ratio of horizontal to vertical axes on the chart as 8 : 4, 9 : 4, or greater, instead of 7 : 4 as here used. The drawbacks to increasing the ratios above 7 : 4 are increased size of cam and high velocity at mid stroke for a given pressure angle.

Elliptical base curve ratio 2 to 4.—The cam produced from the elliptical base curve is shown in the preceding paragraph to give a certain characteristic action to the follower when the ratio of the horizontal axis to the vertical axis is 7 to 4. When the ratio is 2 to 4 a totally different characteristic follower action is obtained, as may be determined by a process of construction similar to that shown in Figs. 116 and 117. The cam itself, with a ratio of 2 to 4, will be much smaller for a given pressure angle, as may be seen by comparing the abscissas of curves No. 5 and No. 11 in Fig. 136. Where it is desired to use a very small cam for a given pressure angle, the 2 : 4 elliptical curve will have an advantage over the ordinary straight-line combination curve above 27°, as may be noted from an inspection of curves No. 5 and No. 6, Fig. 136; but it is at a disadvantage compared with the logarithmic-combination cam at all pressure angles, as is shown by a comparison of curves No. 2 and No. 5.

Elliptical base curve equivalent to nearly all other base curves.—Since the elliptical base curve may be constructed with any ratio of horizontal to vertical axis it has a range of usefulness over the entire field covered by all the other base curves except the logarithmic curve. When the horizontal axis of the ellipse is zero the elliptical base curve coincides exactly with the straight-line base. As the horizontal axis increases in length, the vertical axis remaining constant, the elliptical base curve crosses the straight-line combination curve. When the horizontal axis of the ellipse equals the vertical axis the elliptical base curve is identical with the crank curve. As the horizontal axis continues to increase, the elliptical curve approximates very closely indeed to the parabola when the ratio of horizontal to vertical axes is as 11 to 8. A further general characteristic of the elliptical curve is that the starting and stopping velocities grow smaller and also the accelerations or starting and stopping forces grow smaller as the horizontal axis of the ellipse grows larger.

Cube Curve.—The cube curve gives extremely low and slowly increasing velocity to the follower for a considerable period after starting, as may be noticed by an inspection of the velocity curve *AE*, Fig. 122, which shows the distinguishing characteristic that the velocity curve is tangent to the line *AC*. This curve is the only one that gives uniformly increasing acceleration to the follower, starting from zero, as indicated by the straight inclined line *AD* in Fig. 123. The disadvantage of the cube curve, however, is that it gives an extremely large cam for a given maximum pressure angle if it is used in the same way that the preceding curves are used, that is, if it is made up of two similar arcs placed in reverse order. If the cube curve were so drawn it would be made up of two arcs similar to *AE*, Fig. 120, and the pressure angle factor would be 5.20 as compared, for example, with 3.46 for the parabola, and the maximum radius of the cam would be 5.47 against 3.80 for the parabola.

The characteristic velocities, accelerations and retardations produced by the cube curve cam are shown in Figs. 122 and 123 respectively. From the latter it may be seen that the acceleration and retardation lines *AD* and *FH* respectively are straight inclined lines characteristic of the cube curve. When the retardation line *FH* is extended, as shown by the long-dash line, Fig. 123, it passes through the zero point of the diagram. A cam with this characteristic may have particular advantages in some instances, one of which will be referred to later in the discussion of the relative strength of springs necessary to return the follower.

In the second cases of the circular and cube curves illustrated in Figs. 124 and 128 the follower does not attain full velocity until it reaches three-fourths full stroke. In these cases the follower starts and stops very slowly at one end of the stroke. The velocities at mid stroke are approximately 1.2 and 1.0 as may be noticed from the dash-line construction in Figs. 126 and 130 respectively, against 2.2 and 1.7 as shown for similar base curves in Figs. 114 and 122. The accelerations at the beginning of the return stroke, however, are very high, particularly for case 2 of the cube curve which ranges from 3.2 to 4.8 as shown in Fig. 131. Herein lies the disadvantage of these cams. They are useful only where extremely low starting velocity is required at one end of the stroke and where a rapid change of velocity at the other end of the stroke is immaterial. It would require a powerful spring to keep the follower roller in contact with the cams at high speeds, and if they were used on a positive-drive cam there would be rapid wear at the beginning of the return stroke.

Case 2 of the tangential cam is even worse in this respect, having a greater acceleration on the return stroke, as shown at *EF* in Fig. 135. This tangential cam has not even the advantage of low velocity at the end of the return stroke as have the two preceding cases. This may be noted by comparing the steepness of the velocity lines in Figs. 134, 130 and 126.

Method of determining velocities and acceleration.—The velocity and acceleration values in the diagrams shown in Figs. 86 to 135 may be found by graphical methods which are simple and quite accurate enough for most practical purposes if precision in drawing is followed. The graphical method applies to all forms of cams and starts with the cam chart. Its application, however, is illustrated only in connection with the circular cam chart in Fig. 112, it being unnecessary to add similar lines to all the other chart drawings as the constructions would be the same in every case.

The use of time-distance and time-velocity diagrams.—The chart curve *AEC*, Fig. 112, for our present purpose may be termed a time-distance curve in which

the abscissa *AR* represents time and the ordinates parallel to *AB* represent distances traveled by the follower at corresponding times. If then the time-distance curve were a straight line the velocity of the follower would be constant. We may consider for the instant that the time-distance curve is straight at *E* and draw a straight line *EP* tangent at that point. If this were the time-distance line, and if it were continued for a time period represented by *ED*, the follower would have moved the distance *PD* in the time represented by *ED*. If *ED* is considered as a unit of time, then *PD* becomes a measure of velocity and its length is laid off in Fig. 114, at *XE*, which is at the center of the time-velocity diagram. The length *AC* of the velocity diagram may be any convenient value for the purpose of comparison. The distance *DE*, Fig. 112, or one-half the length of the cam chart, was selected as a time unit because it is a convenient length and because the length of one-half of each cam chart represents the same amount of time in each of the chart drawings. This is because the data are the same in all the cams represented in Figs. 84 to 135. To find other points on the time-velocity diagram divide the time-distance curve by a number of equally spaced ordinates, as shown at *J*, *I*, *H*, Fig. 112. The tangent to the curve at *K*, on the ordinate *JV* is *KM*, and the time unit *KL* is equal to *DE*. Then, from the same reasoning as given above for the point *E*, *LM* becomes a measure of the velocity of the follower at *K* and it is laid off at *ML* in Fig. 114. Similar constructions are repeated at the other points and the time-velocity diagram completed.

The time-acceleration diagrams are found graphically from the time-velocity diagrams by similar constructions. In Fig. 114 a tangent *ES* is drawn to the time-velocity curve at *E*, and if the velocity of the follower is continued along this line for a time represented by *EQ* it will lose a velocity of *QS* in the time *EQ*. Such loss in velocity is retardation and consequently the distance *SQ* is laid off at *ED* at the center of the time-acceleration diagram in Fig. 115. The line *ES* in Fig. 114 was drawn to the left, and consequently downward to make the drawing more compact. In this way retardation instead of acceleration was found logically. Had the tangent line *ES* been drawn to the right, and consequently upward, the value *QS* would have been found just the same and would have been called acceleration. The length of the acceleration diagram *AC*, Fig. 115, may be taken any value; also, the time unit *EQ* in Fig. 114 may be taken any value entirely independent of the time unit used in Fig. 112, so long as the same length of line is taken in all the velocity diagrams as the time unit in making comparisons.

If a definite speed is assigned to the cam then all the lines in the time-distance, time-velocity and time-acceleration diagrams will have a definite value in feet and in seconds, and by closely following these values the diagrams may be scaled so as to interpret them in the ordinary units of feet and seconds, even if arbitrary time lines have been used in constructing the diagrams. For example, suppose that the cam in Fig. 113 is turning at 120 r.p.m. Then it will require $\frac{1}{12}$ sec. to turn through the 60-deg. angle *DOC*, and *DE* in Fig. 112 will represent $\frac{1}{24}$ sec. *DP* measures 0.43 in., or 0.0358 ft. Therefore the velocity of the follower at *E* will be 0.0358 ft. per $\frac{1}{24}$ sec., or 0.859 ft. per second. The scale on *XE*, Fig. 114, would then be graded so that a mark at 0.859 would fall at *E*. In Fig. 114 *AC* represents $\frac{1}{12}$ sec., and *QE* $\frac{1}{48}$ sec. Since *XE* represents 0.859 ft. per second in this example *QS* represents 0.644 ft. per second to the same scale. Therefore the acceleration is 0.644 ft. per second per $\frac{1}{48}$ sec. or 30.9 ft. per second. The scale on *ED*, Fig. 115, would then be graded so that a mark at 30.9 would fall at *D*.

Another set of construction lines for obtaining an ordinate in the acceleration diagram is shown at *LTV*, Fig. 114, where *LT* is the same length as *EQ* and *VT* is the acceleration and is laid off at *VT* in the acceleration diagram, Fig. 115.

Degree of precision obtained by graphical method.—In Fig. 112 the tangent lines may be drawn with precision because the curve *AE* is an arc of a circle, but in the other curves the center of curvature for each of the construction points is not known and the tangent must therefore be drawn by eye. Even here considerable precision may be obtained if in so drawing the tangent it is remembered that the tangent at *L*, Fig. 114, for example, will be practically the same distance from *U* as it is from *E* when it passes each of these points, provided *U* and *E* are on ordinates equally spaced and provided also that the curve *AE* has a fairly uniform rate of curvature on both sides of *L*. If the radius of curvature to the right of *L* should grow noticeably shorter than the radius of curvature to the left of *L* the tangent at *L* would pass a little closer to *U* than to *E*. If in addition to using such judgment as here indicated in the drawing of tangents to irregular curves a sufficient number of points are taken closely together, and if the newly derived curve is drawn smoothly through the average positions of plotted points, a remarkable degree of accuracy may be obtained by the graphical method of obtaining velocity and acceleration diagrams.

Comparison of relative velocities and forces produced by cams having different base curves.—This comparison, which may be made by studying the several velocity and acceleration diagrams in Figs. 86 to 135, is also shown in the table where the maximum velocities of the follower are shown in Column 2 and the maximum acceleration and retardation values in Columns 3 and 4. Since force equals acceleration multiplied by mass, the direct effort required to move the follower is proportional to the acceleration, and therefore the relative direct power needed to operate the follower for various cams is also shown in Columns 3 and 4.

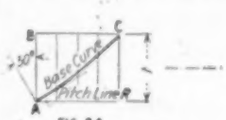
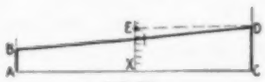
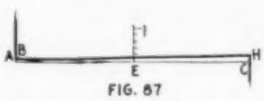
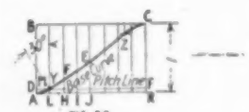
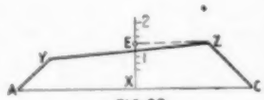
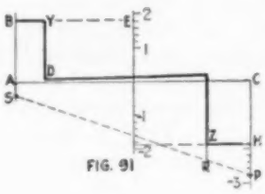
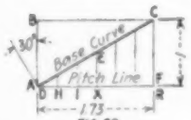
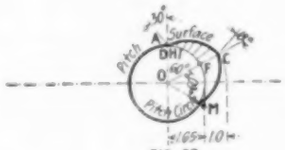
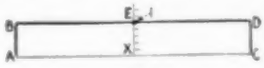
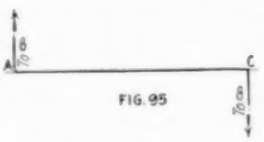
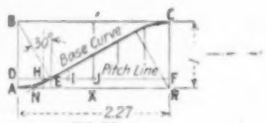
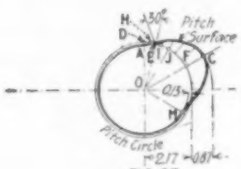
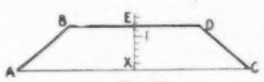
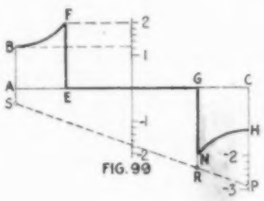
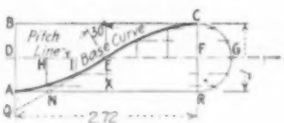
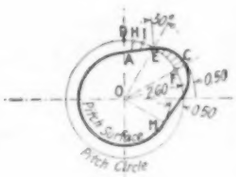
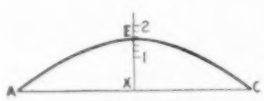
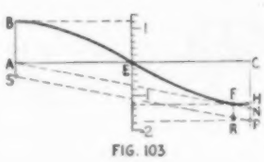
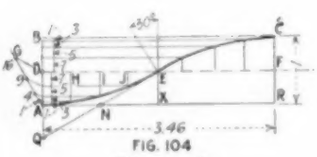
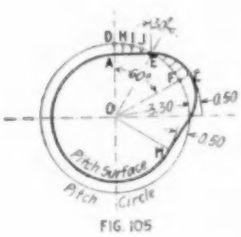
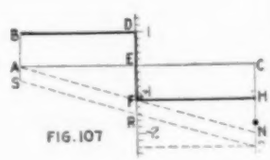
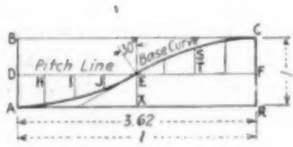
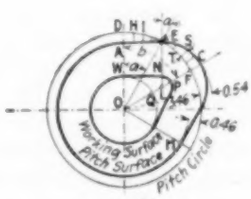
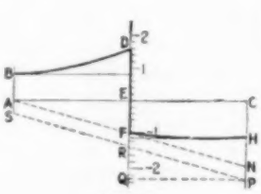
TABLE OF RELATIVE MAXIMUM VELOCITIES OF FOLLOWER AND RELATIVE DIRECT AMOUNTS OF POWER NEEDED TO OPERATE CAM DURING ACCELERATION AND RETARDATION

Form of Cam Column 1	Relative Maximum Velocities Column 2	Relative Amounts of Direct Power Needed to Operate Cam During Acceleration Column 3	Relative Amounts of Direct Power Needed to Operate Cam During Retardation Column 4
All-logarithmic	1.28		
Logarithmic-combination	1.40	1.82	1.82
Straight-line	1.00		
Straight-line combination curve ($r = h$)	1.31	1.99	1.99
Crank curve	1.57	1.25	1.25
Parabola	2.00	1.00	1.00
Tangential curve, case 1	2.09	1.58	1.10
Circular curve, case 1	2.16	1.44	1.44
Elliptical curve	2.28	1.60	1.60
Cube curve, case 1	2.40	1.95	1.95
Circular curve, case 2	2.16	0.96	2.86
Cube curve, case 2	2.79	1.80	4.80
Tangential curve, case 2	3.39	2.55	6.39

The parabola, it will be noticed from the table and from Fig. 107, requires the least direct effort, considering the entire cycle of the follower. This effort is

Comparison of Cams for Different Base Curves, all having same Data

Figs. 84 to 135

Column 1 Cam Charts and Base Curves for one-sixth of Cam	Column 2 Relative Sizes of Cams	Column 3 Velocity Diagrams	Column 4 Acceleration Diagrams
 FIG. 84 All Logarithmic Curve	FIG. 85	 FIG. 86	 FIG. 87
 FIG. 88 Logarithmic-Combination Curve	FIG. 89	 FIG. 90	 FIG. 91
 FIG. 92 Straight Line	 FIG. 93	 FIG. 94	 FIG. 95
 FIG. 96 Straight-Line Combination Curve	 FIG. 97	 FIG. 98	 FIG. 99
 FIG. 100 Crank Curve	 FIG. 101	 FIG. 102	 FIG. 103
 FIG. 104 Parabola	 FIG. 105	FIG. 106	 FIG. 107
 FIG. 108 Tangential Base Curve, Case I	 FIG. 109	FIG. 110	 FIG. 111

Column 1 Cam Charts and Base Curves for One-sixth of Cam	Column 2 Relative Sizes of Cams	Column 3 Velocity Diagrams	Column 4 Acceleration Diagrams

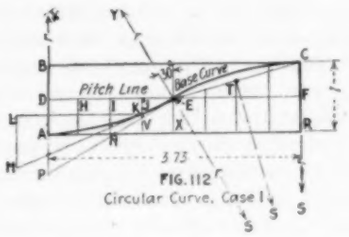


FIG. 112
Circular Curve, Case 1

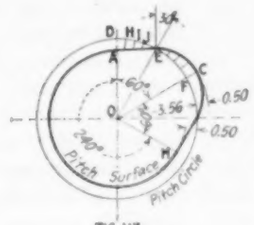


FIG. 113

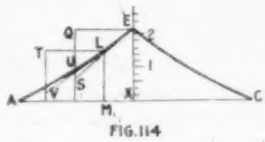


FIG. 114

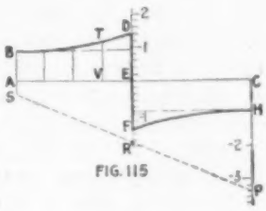


FIG. 115

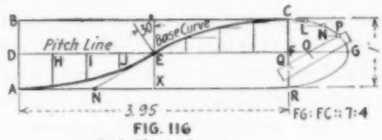


FIG. 116
Elliptical Curve

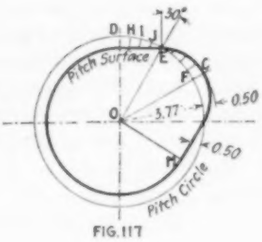


FIG. 117

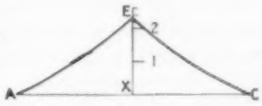


FIG. 118

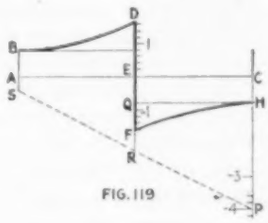


FIG. 119

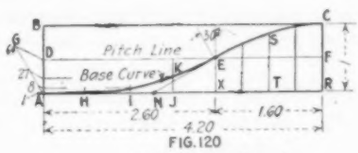


FIG. 120
Cube Curve, Case 1

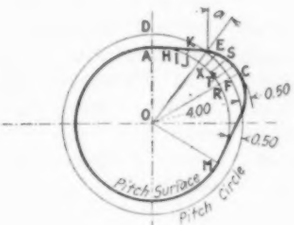


FIG. 121

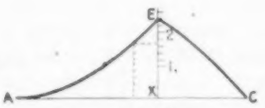


FIG. 122

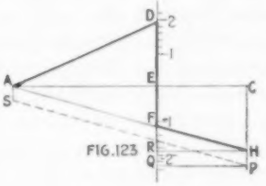


FIG. 123

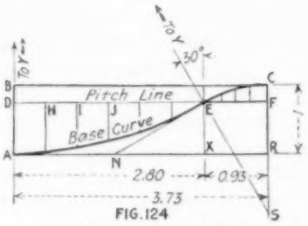


FIG. 124
Circular Curve, Case 2

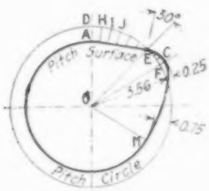


FIG. 125

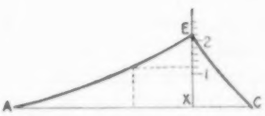


FIG. 126

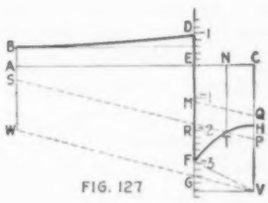


FIG. 127

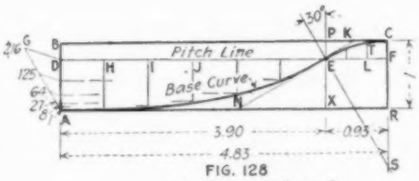


FIG. 128
Cube Curve, Case 2

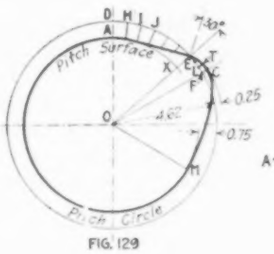


FIG. 129

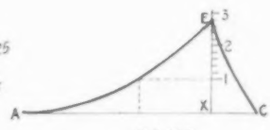


FIG 130

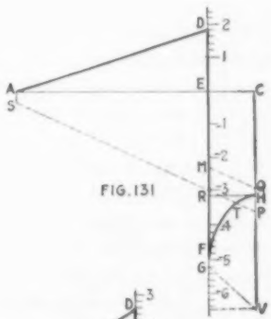


FIG. 131

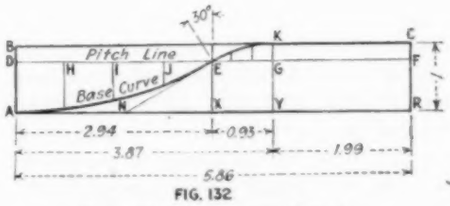


FIG. 132
Tangential Base Curve, Case 2

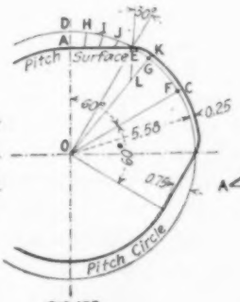


FIG. 133

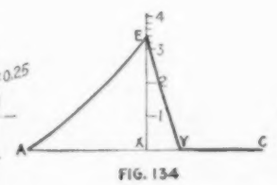


FIG. 134

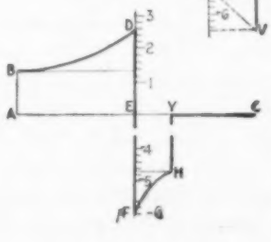


FIG. 135

represented by unity for purposes of comparison. The circular base curve cam, case 2, Fig. 127, requires a trifle less effort than the parabola cam while on acceleration on the forward stroke, but 2.86 times the effort of the parabola, while the follower is on acceleration during the return stroke where a double-acting cam is used. For a single-acting cam the values given in Column 4 show the relative forces necessary to sufficiently accelerate the follower on the return stroke so as to keep it in contact with the cam.

The efforts required by various base curves in comparison with the parabola, which is taken at 1.00, are as follows: 1.25 for the crank curve, Fig. 103; 1.44 for the circular curve, case 1, Fig. 115; 1.58 for the tangential curve, case 1, Fig. 111; 1.60 for the elliptical curve, Fig. 119; 1.82 for the logarithmic-combination curve, Fig. 91; 1.95 for the cube curve, case 1, Fig. 123; and 1.99 for the straight-line combination curve, Fig. 99. These figures are for the symmetrical chart curves. Among the unsymmetrical chart curves shown in Figs. 124, 128, etc., much larger direct forces even may be required to operate the cam as illustrated by the relative maximum values of 2.9 for the circular curve, case 2, Fig. 127; 4.8 for the cube curve, Fig. 131, and 6.4 for the tangential cam, case 2, Fig. 135.

Cam follower returned by springs.—Although the cam built from the parabola chart pitch curve gives the smoothest motion and requires the least direct power to operate it so far as the cam and follower only are concerned there may be other considerations in the design that make or appear to make some other form of chart pitch curve more desirable. For example, when a follower is returned by a positive-drive parabola cam, or when it is returned by gravity, the parabola cam gives the best action because the pull on the follower is constant all the time, but when the follower is returned by a spring the spring reacts on the cam with a uniformly increasing pressure during the outstroke as represented by the straight inclined dash line *SP* in Fig. 107, and with a reverse uniformly decreasing pressure during the instroke.

If the spring pressure acting on the cam is zero when the follower is at rest in its lowest position the spring-compression line would be represented by the straight line *AN*, Fig. 107, starting at *A* and inclined so as to touch the retardation line as at *F*. Inasmuch as there would always be some compression in the spring, even when the follower is at rest, a margin of compression will be taken, as illustrated at *AS*. The practical spring-compression line will therefore be *SP* parallel to *AN*. As the follower moves out, its acceleration during the first part of the stroke produces increasing pressure between the cam surface and the spring-actuated follower as represented by the increasing length of the ordinates from *SB* to *RD*. At mid stroke the follower begins to slow up. In the case shown in Fig. 107 the slope of the spring-pressure line was taken so as to have the same spring pressure ($RF = SA$) on the cam at mid stroke as it has when it is at rest. The line *SP* could have been given a steeper slope if a larger margin of pressure than *RF* had been desired at mid stroke. This would have required a heavier spring. From mid stroke to the end there is again an increasing margin of pressure, the maximum being represented by the difference between the ordinates *PH* and *RF*. The full strength of the spring which would have to be used would be represented by the ordinate *PC*.

Relative strength of spring required for crank, tangential, cube and parabola base curve cams.—Although the parabola cam, with its perfect action as described in preceding paragraphs, permits of the use of a light spring when a single spring is used to return the follower, the crank curve, tangential curve and cube curve cams may each be designed to operate with somewhat lighter springs. Spring-compression lines for each of the three last-mentioned cams are shown at *SP* in Figs. 103, 111 and 123, and the maximum compression required of a single spring in each case is 1.75, 2.35 and 2.30 as compared with 2.40 for the parabola cam as shown in Fig. 107. The return spring pressure between the follower roller and the cam surface when the crank base curve is used is more nearly uniform throughout the *entire* stroke than it is with any other type of cam, as may be noticed from the maximum and the average ordinates between the acceleration-retardation curve and the spring pressure line *SP* in the several diagrams.

Cube curve cam specially adapted for a follower returned by a spring.—The cube curve cam possesses one characteristic over the others in that the pressure between the cam and the follower is absolutely uniform during the latter part of the up stroke and the first part of the down stroke when the follower is returned by a spring, as shown by the parallel lines *FH* and *RP*, Fig. 123. This gives an advantage of smooth-running and uniform wear when the spring is under its greatest compression.

The pressure between the spring-actuated follower and the cam is variable throughout the stroke in all cams except during part of the stroke with the cube curve cam. And it may readily happen that the acceleration called for by the cam is so great that the spring will not be strong enough to keep the follower roller against the cam surface, as may be specially noticed at or near the beginning of the return stroke. This is illustrated in Fig. 127, where the spring pressure against the follower which would be necessary to hold it to the cam is represented by *FE*, whereas if a spring of the same strength as for the cube curve cam, Fig. 123, were used the pressure at the phase *E*, Fig. 127, would be only *RE*. This means that the cam will "run away" from the follower because the spring is not strong enough during the part of the stroke represented by *TFR* to press the follower against the rapidly receding cam surface.

In order to keep the follower roller against the cam surface where cams with large retardation values are used, as in Figs. 91, 99, 127, 131 and 135, a comparatively heavy spring is required which will be unnecessarily strong during a very large part of the stroke, or else two springs will be required, the second one to come into action when needed. Both cases are illustrated in Fig. 127. A single heavy spring that will exert a pressure represented by *WV* will keep the follower roller against the cam surface at all times, the minimum pressure between the two occurring at *FG;* or a single and much lighter spring exerting a pressure represented by *SP*, Fig. 127, may be used, and then a second and shorter spring with an initial compression represented by *ME* may be so placed as to come into action at *E* so that the combined pressure of the two springs on the follower is *ME* plus *RE* equal *FE*. This means that the combined pressure of the two springs will be just sufficient to keep the follower roller against

the cam at phase *E* and that the total pressure of the two springs at the end of the stroke will be represented by *CV*, thus giving an excess pressure represented by *HV* at the end of the stroke. The base curves that are best suited for spring-return followers will be seen to be the crank curve, parabola, tangential curve, case 1, and the cube curve, case 1. The logarithmic and straight-line combination curves come next in order.

Accuracy in cam construction.—It need scarcely be pointed out that the pitch surfaces of cams should be constructed with considerable accuracy and the working surfaces carefully finished if definite results are required, for it may be seen by comparing the pitch surfaces of several of the cams illustrated in Figs. 85 to 133 that a relatively small difference in form may make a large difference in the velocity, acceleration and force or pressure under which the follower operates. For example, the circular curve cam, case 2, Fig. 125, and the cube curve cam, case 2, Fig. 129, are apparently quite similar in form, though varying in size, yet the maximum accelerations which they impose on the follower on the return stroke are quite different, being 2.9 and 4.8 respectively, as shown in Figs. 127 and 131. Also the cube curve cam, case 1, Fig. 121, and the elliptical cam, Fig. 117, appear somewhat alike, yet their velocity and acceleration lines are different in every way, and if a spring were used to return the follower the one for the elliptical cam would have to be enough heavier to carry 1.7 more compression at the end of the stroke than the one for the cube cam, assuming an initial pressure of *AS* in each one. The value 1.7 is found by comparing the lengths *CP* in Figs. 123 and 119.

Regulation of noise.—If a cam follower, as for example a cam-operated disk valve, comes to rest on a seat at one end of its stroke it is evident that it would be desirable for the follower to have the least possible velocity for at least a short distance before it reaches the seat in order to provide against unnecessary striking velocity. Noise will be in some proportion to the velocity of the follower at the instant of seating. With this in mind an examination of the velocity diagrams in Figs. 86 to 134 will show that the cube base curve, case 1, Fig. 120, gives by far the best results, for the vertical ordinates of the velocity curve in Fig. 122 are very much smaller as the follower approaches *A* than they are in any other diagram, excepting case 2 of the cube curve, Fig. 130; but in this instance the advantage is more than offset by the high retardation values at the end of the stroke, as shown in Fig. 131. The circular curve, case 2, comes next in the matter of giving small velocity to the follower, Fig. 126, but it does not possess the advantage of the cube curve when a spring is used to return the follower. The crank curve cam is least adapted of all the cams where quiet seating of a follower is desired, as may be observed by noting that the velocity curve, Fig. 102, for this cam is convex upward, whereas the others are straight or convex downward and thus have smaller initial vertical ordinates and therefore smaller velocity. The full practical advantage of cams which give low seating velocities and consequently a more quiet follower action is offset to a considerable extent where the follower operates a valve which must admit a comparatively large volume of gas or fluid quickly.

High-speed cams.—Cams intended for use on high-speed machines should give the smoothest possible motion to the follower, that is, should be free from sudden variations of velocity during the stroke and from shock due to sudden starting and stopping. A study of the velocity diagrams, Figs. 86 to 134, shows that the all-logarithmic and the straight-line base curves, Figs. 86 and 94, give extreme velocity right at the start in all cases, and that the logarithmic-combination and straight-line combination cams will also give relatively high velocities at the start, Figs. 90 and 98. Therefore none of these cams would in general be suitable for high-speed work. Among the other cams some have an advantage at one end of the follower stroke where the rate of change in velocity is low, but they lose it at the other end where it is high, as, for example, the cube cam, case 2, as shown in Fig. 131; or they lose their advantage at the center or some intermediate point, as in the elliptical cam, Fig. 119.

The cams specified in the preceding paragraph give relatively large sudden change of velocity to the follower either at one end of the stroke or the other or at intermediate positions, and of the remaining cams the parabola cam is the only one that gives absolutely uniform rate of change of velocity to the follower. The crank curve, the circular curve, case 1, and the tangential curve, case 1, give relatively good results, all being at a slight disadvantage compared with the parabola, due to variations in acceleration of the follower. This disadvantage, however, is small, and these three cams, together with the parabola cam, should give best results where there is high speed, provided they are accurately designed and made.

Balancing of cams.—In addition to the forms of the curves here discussed for the pitch surfaces of cams that are to run at high speed it is necessary to design the cam and so place the weight that the cam will be as nearly balanced as possible. This matter of balancing is one of the greatest drawbacks to the use of the cam in high-speed work, for the very nature of a cam implies irregularity in form and hence difficulty in balancing. The face cam cut on a full circular disk comes nearest to a natural balance of any of the forms of radial cams. The trouble due to lack of natural balance in ordinary radial cams may easily be so decided as to render them quite impracticable in many cases where high speed and large stroke are required, unless elaborate balancing problems are solved in connection with the cam design. Small radial cams with small strokes have been made to run at exceedingly high speeds. The cylindrical cam, because of its natural balanced form with respect to the axis of rotation, is most adaptable to high speeds.

Pressure angle factors for 20 deg., 30 deg., 40 deg., 50 deg. and 60 deg. for various forms of cams.—Most of the base curves for cams are of such nature that it is only necessary to multiply the follower motion by a given factor and then multiply the product by 360 and divide by the number of degrees the cam rotates during the follower motion to obtain the circumference of the pitch circle and the proper size of the cam for a given pressure angle. The logarithmic and tangential base curves are of such a nature that no one factor can be used for all data that include a common pressure angle. When these base curves are used, the length of chart, if desired, must be computed by separate formulas for each problem, as explained in Articles VII and VIII. The logarithmic and tangential base curves are most easily applied by constructing the cam pitch surface

directly from calculated values in each problem without the use of any chart whatever.

The factors for pressure angles for all base curves, excepting the logarithmic and tangential, are given in the table of factors for 20 deg., 30 deg., 40 deg., 50 deg. and 60 deg. These factors are also laid off graphically in Fig. 136, thus enabling one to use intermediate values if desired. For partial comparison of the curves which have no general factor with those which have, the special factor in each case for the single comparative problem which has been used throughout in designing the cams in Figs, 84 to 135 is given in the following paragraphs, and these factors are plotted to give the dash lines in the chart for factors.

Varied forms of fundamental base curves.—Several of the base curves are or may be used in practical work with variations in detail of construction, as, for example, in the straight-line combination curve, Fig. 96, the easing-off arc AE has a radius AB equal to the total

TABLE OF PRESSURE ANGLE FACTORS

For Base Curve Nos. 1 to 13 listed in order of corresponding cam size for 30 deg. according to data used for cams illustrated in Figs. 85 to 121; and for Base Curves, Nos. 14 to 16, according to data used for cams illustrated in Figs. 125 to 133.

No.	Name of Base Curve	Factor for Maximum Pressure Angle of 20 Deg.	30 Deg.	40 Deg.	50 Deg.	60 Deg.
1	All-logarithmic	No general factores				
2	Logarithmic-combination	No general factors				
3	Straight-line	2.75	1.73	1.19	0.84	0.58
4	Straight-line combination (Radius equal to ½ follower's motion)	2.92	2.00	1.56	1.31	1.16
5	Elliptical Curve (Ratio of semi-axes: 2 to 4)	3.32	2.17	1.45	1.00	0.68
6	Straight-line combination (Radius equal to follower motion)	3.10	2.27		1.77	1.73
7	Crank curve	4.43	2.72	1.87	1.32	0.91
8	Parabola	5.50	3.46	2.38	1.68	1.15
9	Tangential Curve, case 1 (Length of straight surface not specified)	No general factors				
10	Circular Curve, case 1 (Symmetrical circular arcs)	5.67	3.73	2.75	2.14	1.73
11	Elliptical curve (Ratio of semi axes: 7 to 4)	6.25	3.95	2.75	1.95	1.35
12	Cube Curve, case 1 (Unsymmetrical cube curve)	6.68 4.13+ 2.55	4.20 2.60+ 1.60	2.90 1.79+ 1.11	2.04 1.26+ 0.78	1.40 0.87+ 0.53
13	Cube Curve, case 3 (Symmetrical cube curves)	8.22	5.20	3.56	2.52	1.73
14	Circular Curve, case 2 (Unsymmetrical circular arcs)	5.67 4.26+ 1.41	3.73 2.80+ 0.93	2.75 2.06+ 0.69	2.14 1.60+ 0.54	1.73 1.30+ 0.43
15	Cube Curve, case 2 (Cube curve and circular arc)	7.60 6.18+ 1.42	4.83 3.90+ 0.93	3.37 2.68+ 0.69	2.42 1.89+ 0.53	1.73 1.30+ 0.43
16	Tangential Curve, case 2 (Length of straight surface specified)	No general factors.				

rise of the follower, whereas it would be equally correct in principal to make the radius ½ AB. In this latter case the cam would be smaller for a given pressure angle, but the shock on starting and stopping would be greater. This case is not illustrated in Figs. 84 to 135 but is included under Item No. 4 in the Table of Pressure Angle Factors, and also in the Chart of Pressure Curves, Fig. 136. Likewise the factors for the elliptical base curve having a ratio of 2 to 4 instead of 7 to 4, are given in Item No. 5 in the table and also in the chart, Fig. 136. The factors for a cube base curve made up of symmetrical cube curves are also given in Item No. 13 in the table where it may be noted that this base curve gives an extremely large cam where small pressure angles are desired.

Methods of determining the cam factors.—The methods of computing the cam factors for various base curves are briefly described in the following paragraphs: The letter h in the following formulas represents the motion of the follower and the letter a the pressure angle:

All-logarithmic and logarithmic-combination curves.—These base curves do not have a constant factor for each pressure angle. The radius for the pitch circle in each problem is found by computation and graphics as described in Article VII.

The factors for the data used in the charts shown in Figs. 84 and 88 are:

All-logarithmic cam: 20 deg., 2.28; 30 deg., 1.28; 40 deg., 0.76; 50 deg., 0.42; 60 deg., 0.21.

Logarithmic-combination cam: 20 deg., 2.76; 30 deg., 1.69; 40 deg., 1.04; 50 deg., 0.62; 60 deg., 0.34.

Straight-line base, Fig. 92:

$$AR = RC \cot a = h \times \cot a = 1 \times 1.73 = 1.73.$$

Straight-line combination base curve, Fig. 96:

$$AR = 2AN + 2NX = 2h \tan \left(\frac{a}{2}\right) + h \cot a =$$
$$2 \times 1 \times 0.268 + (1 \times 1.73) = 2.27$$

Crank curve, Fig. 100.—This curve may be regarded as the projection of a helix and therefore DQ equals the length of the quadrant RG, which in turn is equal to $\frac{1}{4}\pi h$. The line EQ is tangent to the base curve at E.

$$AR = 2DE = 2DQ \times \cot a = 1.57\, h \cot a$$
$$= 1.57 \times 1 \times 1.73 = 2.72$$

Parabola, Fig. 104.—In a parabola the subtangent DQ is equal to twice the projected length of the curve AE and therefore $DQ = h$.

$$AR = 2DE = 2DQ \cot a = 2\, h \cot a =$$
$$2 \times 1 \times 1.73 = 3.46$$

Tangential curve, case 1, Fig. 108.—This curve has no common factor for a given pressure angle and the radius of its pitch surface must be computed directly by formulas given in problem 18 without the intervention of a cam chart. For purposes of comparison with other curves the following factors are given: they apply only for the data that have been used in the cams illustrated in Figs. 85 to 133:

20 deg., 5.28; 30 deg., 3.62; 40 deg., 2.82;
50 deg., 2.36; 60 deg., 2.09.

These values are shown in the dash-line curve, No. 9, in Fig. 136.

Circular curve, case 1, Fig. 112.—The chord EC is perpendicular to the line ST which bisects the angle CSE. This angle is equal to the pressure angle. The line EF is perpendicular to CS. Therefore angle CEF equals one-half of the pressure angle. Then

$EF = FC \cot \frac{1}{2} a$, and

$$AR = 2EF = h \cot \tfrac{1}{2} a = 1 \times 3.73 = 3.73$$

Elliptical curve, Fig. 116.—The length of the cam chart for the elliptical curve for a pressure angle of say 30 deg. may be most readily found by constructing several arbitrary elliptical charts, say four, each with a pressure angle factor, or length, of 2, 3, 4 and 5 respectively and each having a common height equal to the rise of the follower. Having constructed the elliptical curve in each of the charts draw tangents in each case as at E, Fig. 116, and measure the angle ENX, which will be the pressure angle corresponding to the factor or length assumed. Then on any coördinate paper plot a curve with the pressure angle factors as ordinates and the corresponding measured angles as abscissas. This curve will cross the ordinate which passes through the assigned pressure angle, in this case 30 deg., and the length of ordinate will give the desired cam factor.

Cube curve, case 1, Fig. 120.—The pressure angle factors for this case in which two unsymmetrical cube curve arcs are used are specially computed by the formulas referred to in problem 20. The value of l in formula 1 when $h = 1$ will give the factor for whatever pressure angle is assigned to a. For a pressure angle of 30 deg.

$$l = 2.427\ h \cot a = 2.427 \times 1 \times 1.37 = 4.20.$$

Circular base curve, case 2, Fig. 124.—The complete factors for this curve are the same as for the circular base curve, case 1, and are found in the same general way. In case 1 the two arcs making up the base curve lower's total motion and that of f is the fractional part of the follower's motion during which acceleration takes place. Then

$$AX = \frac{3 \times 0.75 \times 1}{0.577} = 3.90.$$

The length XR is found in the same manner as in the preceding paragraph and is the same value, namely, 0.93.

Tangential curve, case 2, Fig. 132.—This curve, like case 1 of the tangential cam, has no cam chart, unless it is specially desired to lay it out after the cam is drawn by making special computations based on the

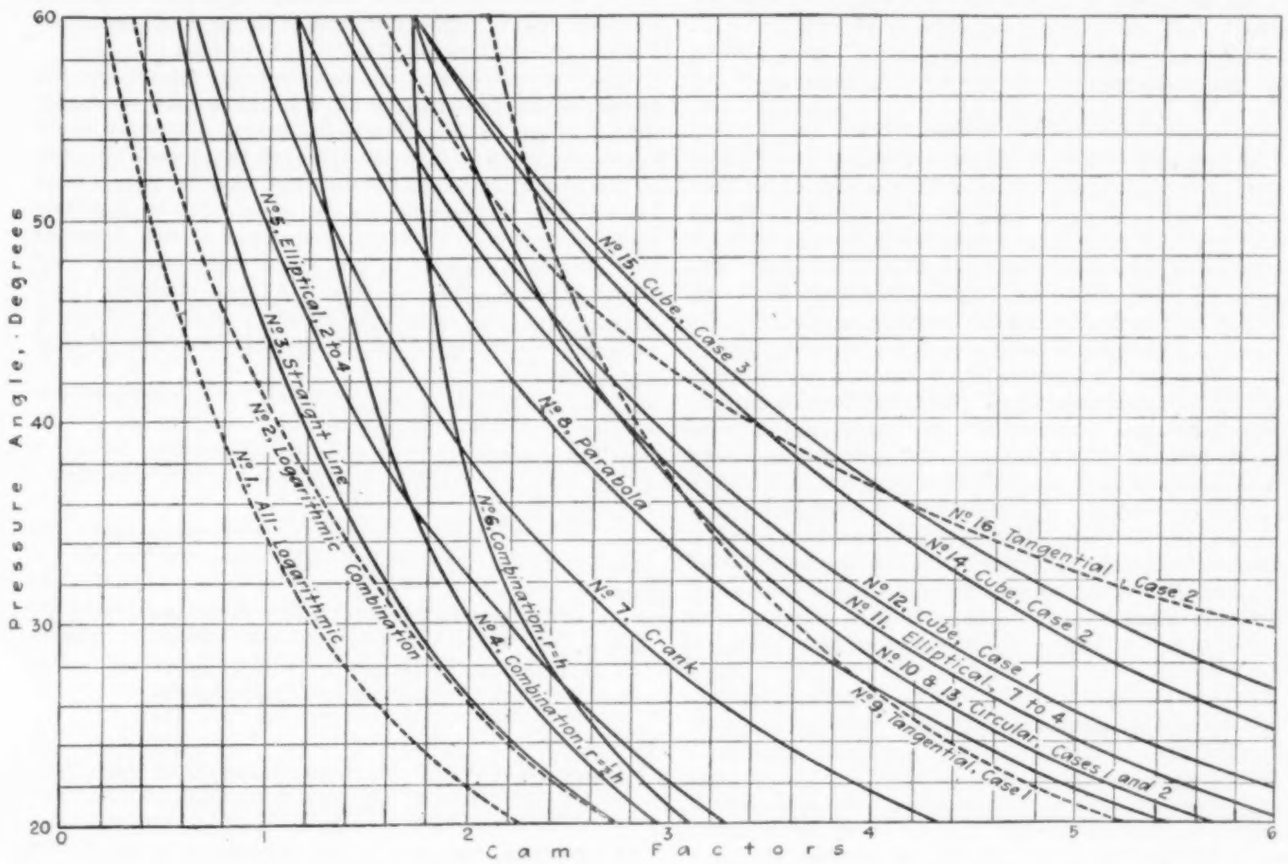


FIG. 136. CHART OF BASE CURVES SHOWING RELATION BETWEEN PRESSURE ANGLES AND CAM FACTORS AND INDICATING ALSO RELATIVE SIZES OF CAMS REQUIRED BY VARIOUS BASE CURVES ALL HAVING SAME DATA

are equal; in the present case they are unequal, but the formula deduced above for case 1 of the circular curve may be used just the same for each arc. In this case 2 the first circular arc is required to lift the follower during three-quarters of its stroke, and therefore the distance AX in Fig. 124 will be $AX =$

$$0.75\ h \cot \tfrac{1}{2}\ a = 0.75 \times 1 \times 3.73 = 2.80.$$

The second circular arc is used for the remainder of the stroke and therefore the distance

$$XR = 0.25\ h \cot \tfrac{1}{2}\ a = 0.25 \times 1 \times 3.73 = 0.93.$$

Cube curve, case 2, Fig. 128.—In this case the cube curve is used for three-quarters of the stroke and a circular arc for the remainder of the stroke. The formula $x = \frac{3fh}{\tan a}$ is used to compute the part AX of the cam chart length. The value of h is the follpitch circle as described in problem 18. For purposes of comparison the data used in this cam, as drawn in Fig. 133, are the same as for all other cams in Figs. 85 to 133, and for the data so used the pressure angle factors are:

20 deg., 13.02; 30 deg., 5.86; 40 deg., 3.36;
50 deg., 2.20; 60 deg., 1.57.

These values are shown in the dash-line curve, No. 16. in Fig. 136.

Preventing Accidents in the Shop

BY J. E. BULLARD

Familiarity is said to breed contempt. That this is so is no doubt the reason why much more has not been done to reduce industrial accidents.

Each year wage earners in the United States lose, through not taking sufficient care of their health and not

being careful enough about avoiding accidents, not less than half a million dollars. In these days of underproduction and overdemand this sum is well worth saving for both worker and producer.

Preventing accidents does not depend alone upon providing safeguards. The men must be taught to appreciate these safeguards. During the war it was necessary to devote a great deal of time to teaching the men that the helmet and the gas mask were necessary safeguards. As it was many men lost their lives through personal carelessness.

Preventing accidents, therefore, becomes a selling problem as well as an engineering problem. Unless the men can be made to take a real interest in protecting themselves all the mechanical safeguards that can possibly be used will not prevent accidents. It is at this point that salesmanship and advertising come in.

Advertising "Safety First"

Both rail and trolley roads have found it effective to advertise "safety first." A certain railroad found that so many motorists drove into or in front of its trains that the court proceedings were proving very costly and annoying. Gates would not prevent accidents. The drivers of heavy cars would drive right through the strongest gates that could be installed and crash into the train. No sort of mechanical warnings or safety devices served their purpose and it was too expensive to eliminate all grade crossings. For this reason posters, cards in the cars, illuminated signs on all the railroad bridges crossing the highways, and newspaper advertising were used. From the time that the advertising began the number of accidents decreased. They decreased for two reasons: People began to use better judgment in crossing the tracks and those who did meet with accidents were not receiving as much sympathy, and the railroad was not blamed to the extent as was the case before it began to advertise the advisability of greater care.

We have all seen at some time or another advertisements by trolley companies showing people how to get on and off cars. This has helped to reduce accidents.

In the shop, as well as on the road and in the cars, advertising will tend to reduce accidents. Use posters, bulletins, pay-envelope slips, etc., to bring to the attention of the workers, and to keep before their attention, the need of precaution in regard to accidents, *and the accidents will fall off even though nothing more is done.*

Follow up this advertising with precautions to be taken in the way the men are clothed and the machines guarded and the accidents can be reduced to a minimum. Today machines are usually provided with safety guards anyhow. These guards serve the double purpose of protecting the machine and of preventing accidents to the worker. Hardly enough attention, however, is given to the clothing.

Now when productive labor is so essential it is more than ever necessary to guard against avoidable accidents and for this reason more attention should be given to the clothing of employees. It is loose ends, dangling shoe laces, flowing sleeves, unbuttoned jumpers, and such things that are fertile sources of accidents.

The engine lathe is not a dangerous machine but anyone who has spent many years in the shop can recall some accident caused by some part of the clothing being caught in the gears, in a dog holding the work, or in the work itself. This shows the need of close fitting clothes free from all loose ends and the advisability of keeping all of the clothes buttoned while working around machinery.

The shoes worn should be both strong and comfortable with good soles. It is a mistake to wear shoes with soles so thin that they do not protect the bottom of the feet. One can never tell when he will step upon a nail or sharp piece of metal that will pierce an old worn-out sole but which would not do any damage if the soles were in good shape.

If lace shoes are worn, every workman should keep the ends of the laces tucked inside the shoes. Loose laces have a habit of catching upon things and may cause falls that have serious results. In fact, the wearing of puttees that would cover the shoelaces and hold the lower part of the trouser legs firmly in place would tend to prevent many falls.

When working around any sort of machinery the sleeves should be buttoned close to the wrists, or snugly fitting short sleeves should be worn. In some cases employers are going so far as to sell the proper clothing to the men at cost. There does not seem to be any good reason why this should not be done. If the men buy their work clothes from their employer at cost it means that they will be able to buy them much cheaper than would otherwise be the case. All the clothing being alike means the minimum of stock and all of them buying from the employer means the maximum of buying power.

Every employer knows that even though a particular accident may not cost him anything in damages it does cost him something in slowing up production, for after an accident production does not come up to normal again for some time.

The prevention of accidents, however, cannot be accomplished by compulsion. The men must be sold the idea of precaution. They must be shown that it is to their advantage to use every precaution against accident. They must be shown that each accident means a loss to everyone concerned. Accident prevention is as much a matter of education as of safeguards.

Effect of Great Pressure on the Electric Properties of Metals

In the great majority of the metals tested by Bridgman, increase of pressure lessened the electric resistance, antimony and bismuth being the only exceptions.

According to the hypothesis of dual electric conduction the total conductivity of the metal is the sum of the conductivity due to the action of the associated electrons, and that due to the action of the free electrons. It seems that increase of pressure should increase the former and decrease the latter; and as the former is probably much larger than the latter in most metals, we should expect the usual effect of increase of pressure to be an increase of total conductivity, as it is in fact. But in the case of metals for which the ratio of the two phases of conductivity is exceptionally large, as it probably is in antimony and in bismuth, especially the latter, we should not be surprised to find increase of pressure producing a decrease of total conductivity, as it does.

In most of the metals tested by Bridgman, increase of pressure produces such an effect that heat is absorbed when a stream of electrons goes from the compressed to the uncompressed metal, this effect being especially large in bismuth.—*Brass World.*

The Production and Instruction in an Apprentice School

By PETER F. O'SHEA

Realizing the necessity for training boys to fill executive positions as well as to maintain the supply of machinists and toolmakers, the Greenfield Tap and Die Corporation of Greenfield, Mass., long ago instituted a school to be run in connection with its plant. Located in the company's special product plant and next door to the toolroom, the school is ideally situated in respect to the class of work available, so that while the students are not tied down to tedious repetition work and production methods, such product as the school turns out is of commercial value and renders the institution practically self-supporting.

ONE difficulty in an apprentice school is to combine efficient production with efficient teaching. To accomplish these two objects at once, the best place to locate the school is where it can get a combination of two things: small production orders, such as in a semi-job shop, and toolroom work.

The apprentice school of the Greenfield Tap and Die Corporation is situated on the top floor of the building which is now devoted to the making of special taps: that is, taps and holders which are made in such small batches that they are not assigned to the regular quantity-production plant. The next room to the apprentice school is the plant toolroom, and the door between always stands open. An idea of the equipment and arrangement of the school may be gained from Figs. 1 and 2.

It is evident that some of the simpler operations upon many of the small orders that come to the special tap plant may be diverted to the school without at all inconveniencing the regular course of manufacture on the floors below. The school may also do preparatory work for the toolroom or even carry some of the simpler jobs to completion, and when the apprentices are well trained they may take on almost anything that comes along.

Production Work

On production orders which are accepted by the apprentice school one boy at first does one operation. He lays out his work, describes what he is going to do, and sets up his machine, under the tutelage of a supervisor. After the operation is done, he may be shifted to another on the same product.

At first he does not complete the order, but as far as he goes he is required to submit a sketch of everything he does. He must understand, and perhaps sketch, the work done by other boys on the same product, and know the purpose of each operation.

Each boy's main business is to understand what he is doing; production is incidental. If he doesn't thoroughly understand why he is to do a certain thing, he is supposed to ask the instructor. The superintendent makes it a point quietly to stop beside a boy at unexpected moments and question him regarding the nature and requirements of the work he is doing. If the boy does not understand, he is in disgrace. It is impressed upon him that knowing what he is doing must accompany doing it.

The work done on a quasi-production scale includes milling-cutters of all shapes for fluting taps and other work in the production departments; large numbers of chasers, which are inspected to close limits; and reamers, countersinks, etc., used in manufacture of dies.

Certain orders similar in form though differing in dimensions, are frequently sent up by the tap plant so that they get to be a standard article in the school. After a boy has worked on each of the operations on that product a sufficient number of times to be familiar with them he is assigned to follow a lot through, making the complete product himself on successive machines. Thus, he learns the correlation of operations in the best way possible by doing them himself after he has already learned each step.

The production orders from the factory not only help the school make a profit, but are very beneficial to the students. A boy, while starting out to be a toolmaker, may afterward be called upon to be a foreman, since about the only way in which the thorough mechanical training necessary to a machine-shop foreman can be acquired nowadays is either in the apprentice school or in the toolroom.

A foreman's main business is getting out production, and anyone who expects to hold such a position should have a basic training not only in each individual operation which can be applied to machine work, but in the laying out of successive stages and in scheduling of work. The best way to learn this is to follow certain typical products.

Boys learn very quickly under proper teaching. They learn quickly enough so that while on the successive steps of their progress they are of production value, provided the kind of production is fitted to the school.

Toolmaking Work of Apprentices

Working on production orders accustoms the boy to the use of machines in set-ups which are more or less standardized. After he gets into the way of setting up a machine he may be given some work on a part of a special tool or jig from the toolroom, which gives him experience in setting up jobs that he never saw before.

The tool work he does at first is the simplest possible preparatory operation. He has to lay out the work, make a sketch, and know what operations are to follow his, and why. Soon the boys get so that they can follow the logic of the progressive operations when making simple tools, and then the more complex ones, even though they cannot yet make the complete tools themselves. This stimulates their desire to learn the more advanced operations necessary to complete the tools. They are allowed an opportunity to do advanced work as fast as they prove themselves able to do it accurately and in fairly good time. A boy needs to be taught efficiency and he is not really ready for advanced work until he can, after a preliminary survey, go at it in workmanlike manner.

The superintendent is careful not to assign new work to a boy until he is capable of doing it well, for that would tend to create a habit of doing sloppy work or of "bluffing." On the other hand, it is desirable to give the boy new work as soon as he is ready for it, so that he will constantly exercise the habit of learning, and also have the encouragement of visible progress. During the last twelve months of his course a boy gets enough complicated tool work to do all by himself to enable him to say that he has learned the toolmaker's trade.

The kind of special tool work first given to the more skillful boys is jig and fixture work and the making of special forming tools. Three boys are at present on model work, each boy making a model complete from start to finish.

Costs

For the reason that a boy does not take up difficult work until he can do so with a reasonable degree of efficiency, he is able to do it at a reasonable cost. In fact, the apprentice, knowing that as soon as he finishes one kind of work he can go on with a new variety, tackles each job with eagerness. If he has been properly taught, he can finish up the job well and quickly and the cost may be less than would be the case if the work were done by settled workmen with permanent status and slower progress.

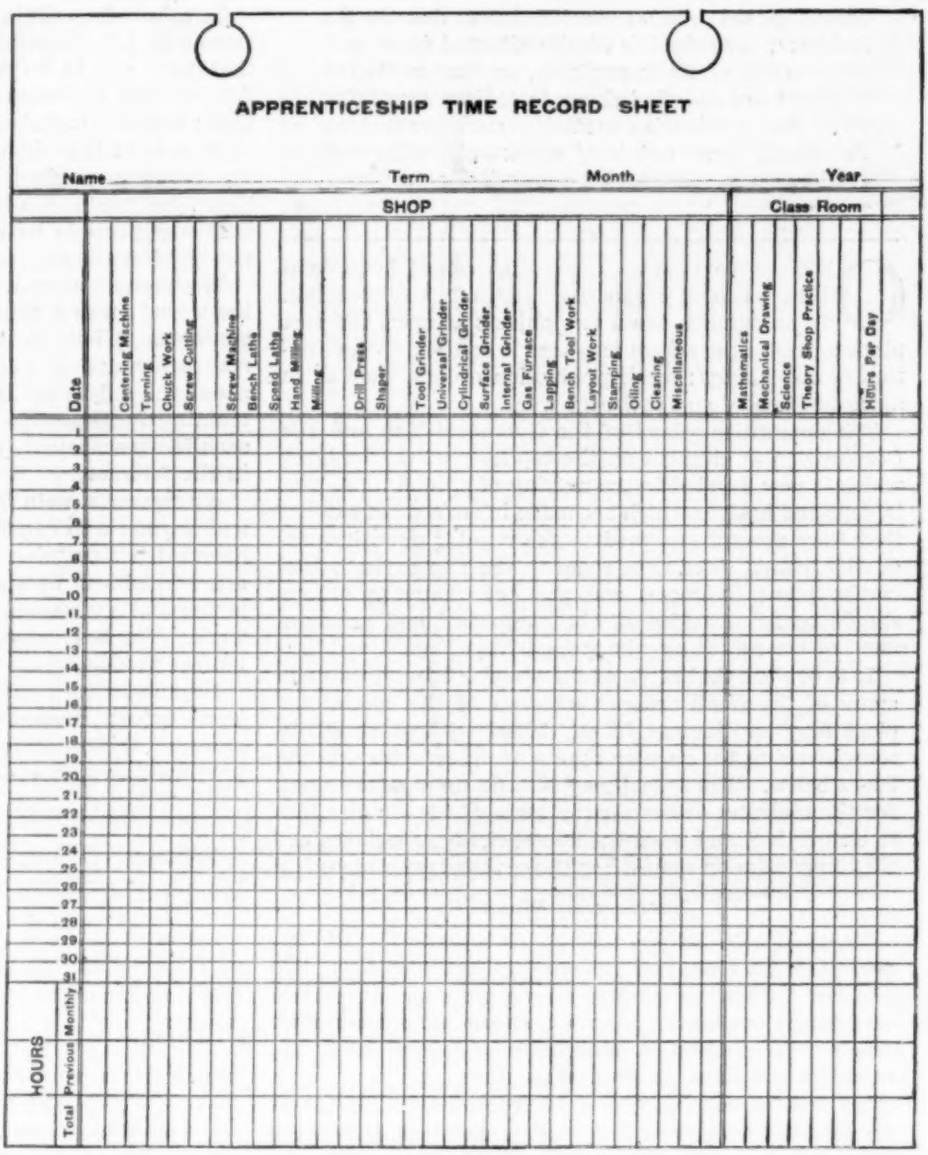
When a production order or toolroom job is done in the apprentice school, the school is credited by the tap plant with the shop cost of such work, which is accurately known. The school is entirely independent of the plant management. It simply leases, so to speak, one end of the floor, for which it is charged a proportional amount of the overhead of the building, in lieu of rent. Equipment, time, etc., are all recorded; therefore, the costs and the earnings of the school are known.

The apprentice school has the reputation of being among the more efficient departments of the corporation. This is as it should be, for apprentices should always have about them a correct example of modern manufacturing. Methods which do not make money are not practical. The earnings of the school exceeds its total expenses, including overhead, equipment, wages, supervision and instruction, by an amount sufficient to give a fair profit on the 40 x 60-ft. space occupied, even considering the school in comparison with the production departments.

The care with which the superintendent assigns work according to the advancement of each boy goes a great way toward the success of the school, both in making it self-supporting and in accomplishing its main purpose, which is to teach the boys to become skillful, accurate and efficient.

How can the superintendent be sure that in all this production work he doesn't lose sight of the interests, training and progress of any one boy? How is he sure that each boy receives his due all-round experience and omits nothing?

A clerk keeps a record of the hours a boy spends on each machine and operation. A sheet for each apprentice for the current month is in the top of the loose-leaf ledger.


APPRENTICESHIP TIME RECORD SHEET

Name ..... Term ..... Month ..... Year ....

SHOP | Class Room

Date | Centering Machine | Turning | Chuck Work | Screw Cutting | Screw Machine | Bench Lathe | Speed Lathe | Hand Milling | Milling | Drill Press | Shaper | Tool Grinder | Universal Grinder | Cylindrical Grinder | Surface Grinder | Internal Grinder | Gas Furnace | Lapping | Bench Tool Work | Layout Work | Stamping | Oiling | Cleaning | Miscellaneous | Mathematics | Mechanical Drawing | Science | Theory Shop Practice | Hours Per Day

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

HOURS — Previous Monthly — Total

FIG. 1. BOY'S MONTHLY RECORD SHEET

This sheet, Fig. 1, is divided from left to right into columns corresponding to the various kinds of equipment and operations. From top to bottom of the printed form there are 31 spaces, one for each day in the month. The center of the sheet forms a checkerboard over which at the end of the day the clerk distributes each boy's hours from the time cards, setting

down in the appropriate square under each kind of machine the hours spent on it. At the end of the month she adds up each column in the space designated "monthly." The number of hours the boy has previously spent on that machine during his course are added to this to get totals to date, which are along the bottom of the sheet. This sheet shows the variety of equipment in the room, which is compactly arranged as will be evident from a study of Fig. 2.

If on any boy's monthly sheet the total hours given to any one machine appear insufficient the clerk calls the attention of the superintendent to it and he adjusts the discrepancy in his next assignments. A boy is free at any time to look over the record sheets and call the attention of the superintendent to any apparent discrimination. Each boy also knows each other boy's sheets and all idea of unfairness or favoritism is driven out of his mind. This is an important help to the morale of the school and the eagerness of the students to learn.

At the beginning of each month a new set of record sheets is inserted at the top of the ledger, and the total hours from the previous sheets are at once brought forward into the "previous experience" column near the foot of the fresh page; thus the superintendent always has facing him on each boy's current sheet a record of the boy's entire experience. The sheets for the past months remain in the back of the ledger and may be consulted in detail at any time. The records of all the boys are also consolidated into one large master sheet, so that it will be easier for the superintendent to compare boy with boy and get a bird's-eye view of the class progress.

On a separate sheet which is not shown here, a report of the progress and standing of each boy is mailed to his parents at the end of every three months' term. On this sheet the boy is graded either A B C or D in accomplishment, progress, class work, and general habits. A term report is not only due the parents as the only way of helping them to keep their boys up to the scratch, but has a strong moral influence within the school, since each boy has a certain pride in his comparative record as a workman.

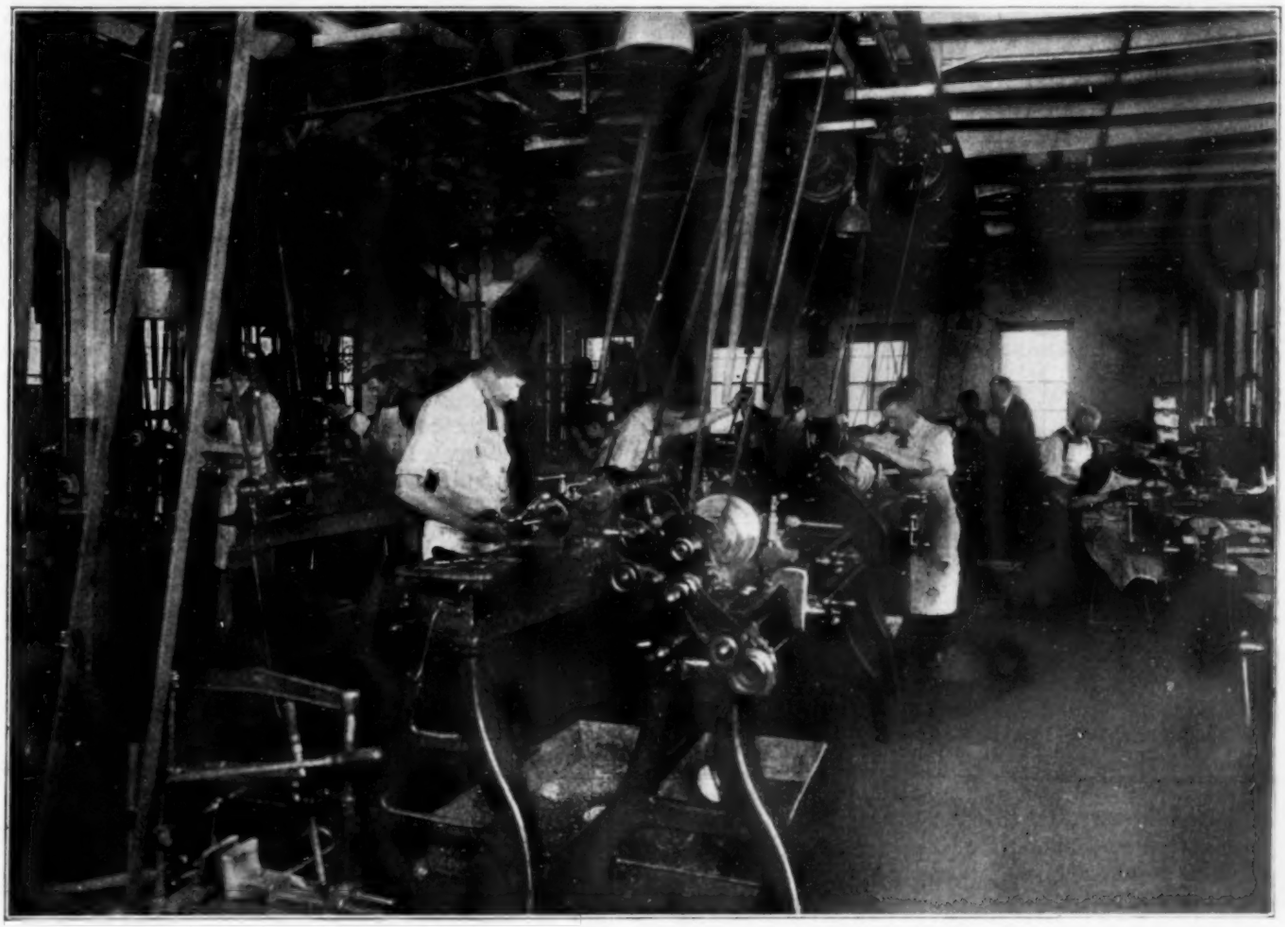


FIG. 2. APPRENTICE SCHOOL OF GREENFIELD TAP AND DIE CORPORATION

There are probably three important elements which go to make the school successful. The first is the location of the school with its opportunities for obtaining proper work. The second is the personality of the instructor. The third is the personality of the boys.

The superintendent of the Greenfield Tap and Die Corporation school is a first-class toolmaker, who has also had wide experience as a foreman, both of production departments and in toolrooms. Though not a youngster, he understands boys and has a sympathetic way with them. He is classed as a superintendent rather than a foreman, and has reason to be proud of his success with the school.

Under him there is a supervisor to every five boys. A supervisor must be a first-class workman, as otherwise the apprentices would soon surpass him. It is his duty to set up machines for beginners, train the boys

as rapidly as possible, and coach the more advanced apprentices upon special work.

The clerk who keeps the boys' records is also dispatch clerk for the room; that is, she keeps track of accepted orders, makes out production tickets, keeps the production record of each machine, is the time clerk, the cost clerk, and the payroll clerk—so far as there is one in the room—and does all other clerical work of the school. The "office" is shown in Fig. 3.

The Boys—An Important Element

The third element in the school is the personality of the boys, who are the real raw material and will be the real finished product.

The boys for the course are chosen with considerable care. Each boy seeking instruction is required to fill

FIG. 3. THE "OFFICE" OF THE SCHOOL

out an application, answering questions as to his personal history and experience, if any. The answers and character references are invariably looked up and checked. The boy should have at least the equivalent of a grammar school education and be physically strong, of good character, and of average ability. It is important that he shall have in him the desire to succeed in the toolmaking trade, and that he be mechanically inclined. It is essential that the boy shall have the hearty coöperation and support of his parents. If a boy is desirous of entering, but there is no opening, he is put on a waiting list and sent for when the opening occurs.

Each boy joins the school on probation for the first term of three months. This term counts in his course if he stays. Every boy has to serve this term of probation, including those who enter with advance standing. At the end of this time the superintendent of the room is in a position to decide whether the boy has in him the qualities necessary to make good and complete the course.

The Length of the Course

The course is laid out in a number of hours which will, under normal conditions, cover practically three years. Each year is divided into four terms of approximately three months each. This includes classroom work weekly.

Allowance of from one to four terms of advance standing is offered to well-recommended young men who have had one year or more of varied experience with machine tools, and to graduates of technical high schools. But these apprentices are also on probation for their first term.

There is a difference of about 90 hours per year between the yearly hours specified for the course and the total of working days in a year. These 90 hours are allowed to provide against illness or other unavoidable absence, or the apprentice may use them for a vacation each year if he has completed his required number of hours for that year.

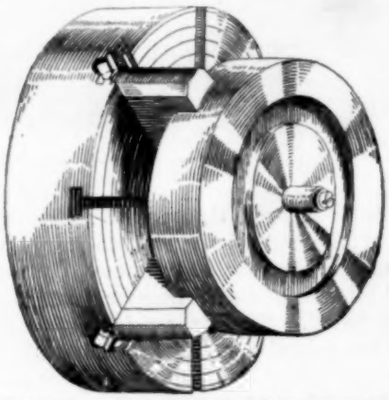
The classroom work referred to consists of not less than five hours a week—usually one afternoon—of drafting, sketching of parts on which work is being done, and shop arithmetic. Classes are held in the dining room of the adjoining plant, with the tables cleared to one side and drafting boards installed during the hours of the class. The formal sketching mentioned is done on a drafting board and is in addition to that done in the shop in preparing work. The instructor is a competent man who used to be on the staff of a large technical high school, and who is now in the engineering department of the corporation. He gives one day each week to the school.

The pay for the school apprentices was started at the rate of 14 cents an hour for the first term, with an advance of one cent an hour for each term, so that at the end of the course the pay would be 25 cents an hour. Realizing that this rate was too low under present conditions, the company in 1917 gave the superintendent authority to pay the boys a bonus up to as high as 20 per cent. depending on their efficiency. Upon completion of the course, the company pays each boy a bonus of $100 in cash and gives him a set of tools, complete enough to meet his requirements as a toolmaker, at a cost of not less than $60.

A Precaution in Boring Large Holes

By Gustave A. Remacle

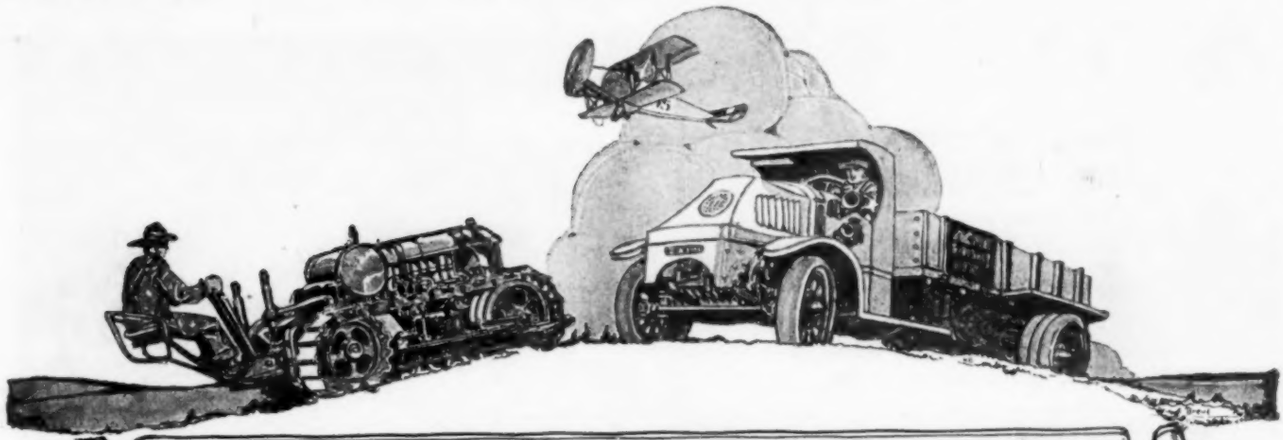
When a job has been clamped to the faceplate of a lathe and adjusted to run true either by means of a button or prick-punch mark, before the button or mark has been removed or disturbed I often machine a groove as shown in the sketch, carrying it out almost to



A PRECAUTIONARY MEASURE IN BORING

the ultimate diameter of the hole to be bored. Should the job shift during the roughing out process, the error can be easily detected and corrected by indicating this groove.

Without this precaution I would be in constant fear lest the job shift and would work very carefully in pushing a large drill or taking a heavy boring cut. It takes but a few minutes to machine this groove because only one side need be smooth and run true.



AUTOMOTIVE CONSTRUCTION

Building "Quad" Trucks for the Army

By HARRY SATTERTHWAITE

The need of the army for trucks of the "Quad" type for field work, intermediate between that of the standard trucks and of the tractors, made necessary the utilization of automobile factories which had had no experience in this sort of work. This article describes the progressive assembly of the chassis at one of these plants and also several machining operations on chassis parts.

WHEN the United States entered the war, the Government was faced with the necessity of securing an immense amount of material, much of which was not being produced in sufficiently large quantities to meet the demand. Motor trucks were one of these prime requisites, especially those with power on all four wheels, commonly called "Quads." These were used principally for hauling artillery, ammunition, mobile repair shops, and heavy supplies, and were absolutely indispensible where the "going was bad" near the front.

At the time of the Declaration of War, the Government had no completed and tested design for the four-wheeled-drive trucks, and to facilitate delivery adopted two trucks of this type which were being produced commercially, and which had been in use by the allied countries in the preceding years of the war. These trucks were of different types of drive; one using the conventional passenger construction, the full floating axle, and the other having the internal gear drive as used on a number of commercial vehicles. Each of these types has its champion and each its advantages from some standpoint.

Because of the large number of trucks needed in a short time it was necessary that other factories than the parent companies should engage in their production, and, consequently, several plants were turned over to this work without their having previous experience or special facilities for its performance.

Prominent among these was the National Motor Car and Vehicle Corp., Indianapolis, Ind., large manufactur-

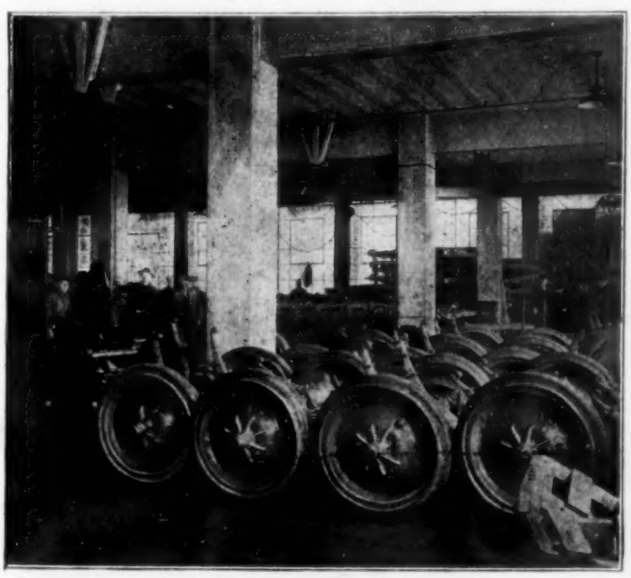


FIG. 1. AXLE ASSEMBLY ROOM SHOWING MONO-RAIL TROLLEY

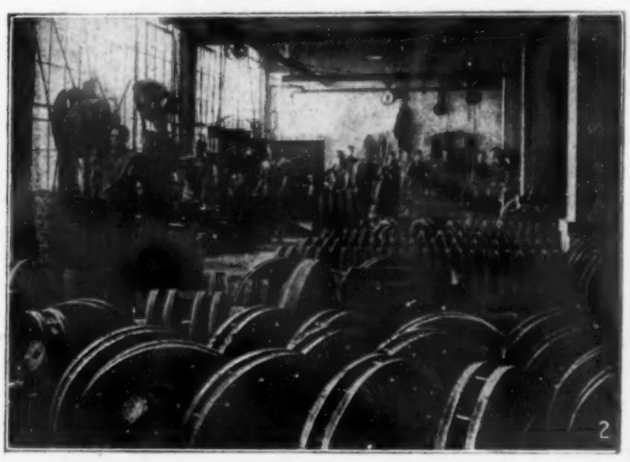


FIG. 2. "QUAD" WHEELS IN THE SEPARATE ASSEMBLY ROOM

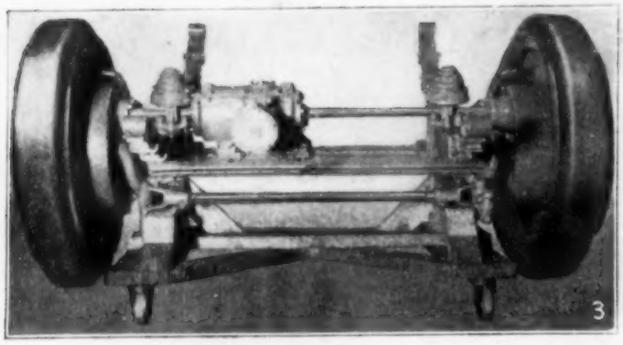


FIG. 3. AXLE ON "DOLLIE"

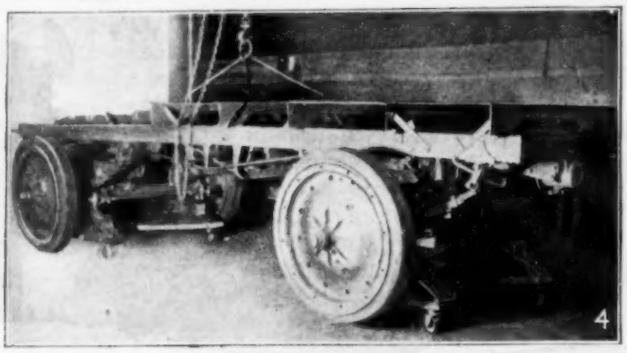


FIG. 4. ASSEMBLING FRAME AND AXLES

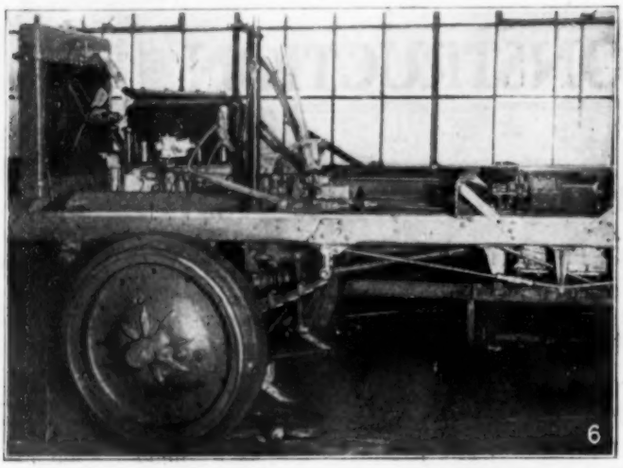


FIG. 6. ASSEMBLY OF RADIATOR, STEERING GEAR, ETC.

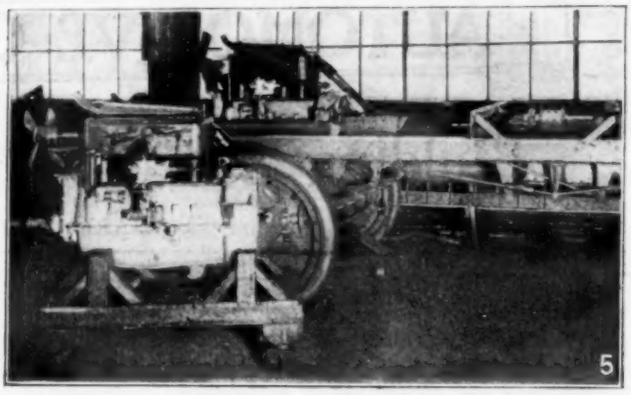


FIG. 5. INSTALLING MOTOR AND TRANSMISSION

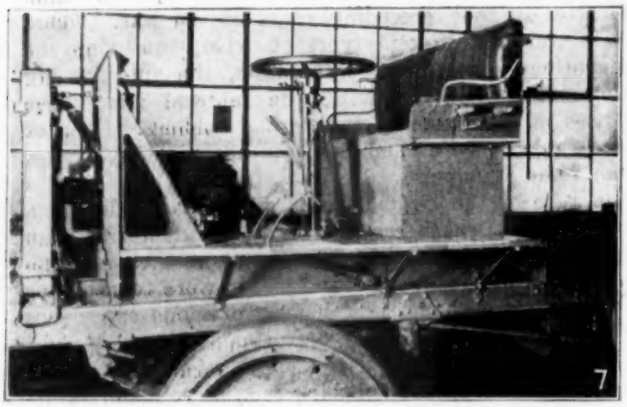


FIG. 7. THE SEAT AND PLATFORM MOUNTED

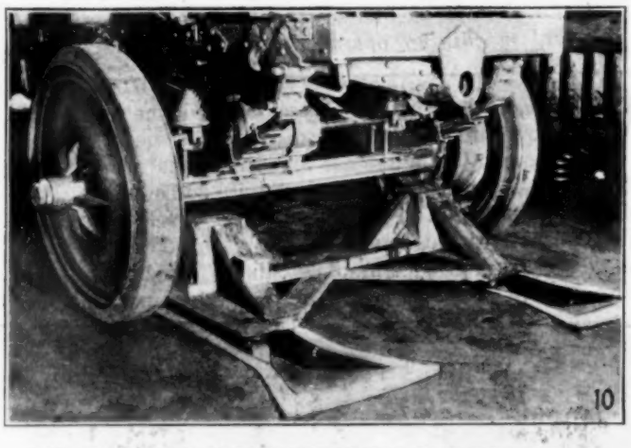
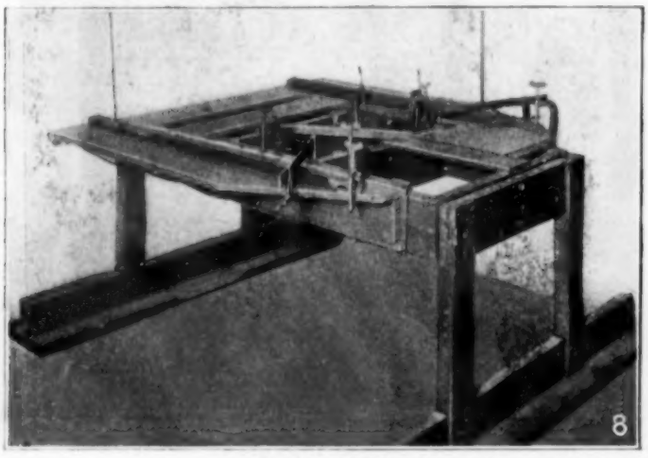
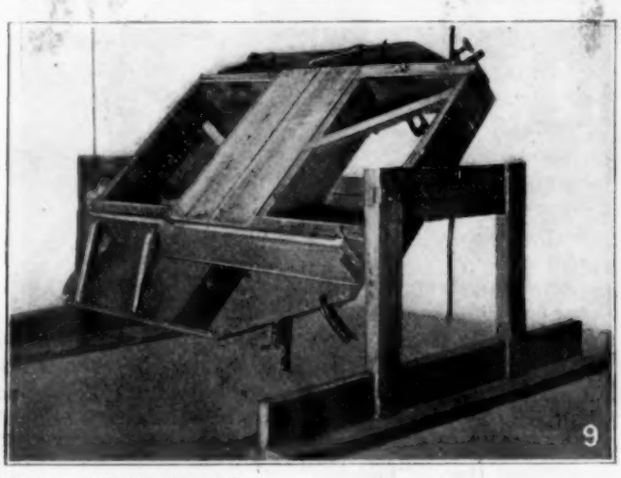


FIG. 10. ON ITS OWN WHEELS FOR THE FIRST TIME





FIGS. 8 AND 9. THE PLATFORM ASSEMBLING JIG

AUTOMOTIVE CONSTRUCTION

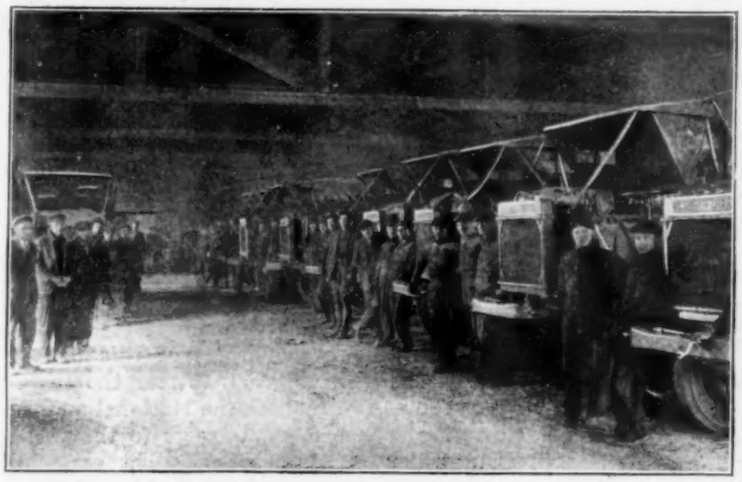


FIG. 11. ROAD-TEST GARAGE

ers of high-grade passenger automobiles, who undertook the manufacture of several thousand of the trucks with the internal gear drive. They constructed and installed the special equipment and facilities, illustrated and explained in this article, which enabled them to make an enviable record in the production of the trucks so badly needed by the Government.

Not having machine equipment of the type and amount necessary to manufacture the larger units, they were forced to sublet them to specialists in these lines. The motors and transmissions were made by the Haynes Automobile Co., under license from the Buda Co., and the axles were made by the Columbia Axle Co. These companies coöperated to the best of their ability in the rapid production.

The National factory, like "Topsy," just "grew up." Being one of the oldest manufacturers of motor cars in the country, its plant has been added to as the business increased and, because of its restricted surroundings, these additions have not resulted in as perfect an arrangement for manufacturing as is enjoyed by some of the companies entering the field in later years in a big way and having plants erected to suit their specific needs.

The part of the factory formerly used for final test and shipping purposes was used for the truck assembling. An electric mono-rail hoist system was installed reaching from the loading platform in the rear, alongside the assembly building and into the opposite end, thence back through the building to the center. A switch in the track connected with the general storeroom, thus providing means of quickly unloading bulky material and carload lots, depositing them at the entrance of the storeroom where the receiving inspection department was located. This mono-rail was also used to bring truck frames from storage to the starting end of the assembly line, and is shown on the inside of the building in Fig. 1.

The first operation in the truck assembly is to spray the frames, as they are brought in on the mono-rail, with the olive-drab paint which has become so familiar to all. This is done in a large booth equipped with motor-driven exhaust fans which carry the fumes away from the workmen.

In equipping for the truck production a central paint tank was provided, with a circulating pump to supply all the spray equipment in the various parts of the building. In this manner all the paint was of the proper consistency; there was no loss from evaporation and no lost time from operators constantly replenishing their supply. The paint was kept in constant circulation at the desired pressure which was controlled by an automatic valve.

The frames were passed on to a drying station and from there moved to the next station where the brackets not furnished with the frame were applied. When this operation was completed, the frames were placed on a caster-equipped wooden truck, and moved to the next station where the axles were attached.

Both the front and rear axles were fitted with springs, wheels, propeller shaft companion flanges, grease cups, etc., adjusted and greased in a separate assembly room located in the same building, Fig. 2. In this department they are placed on wood "dollies" mounted on casters, and delivered to the assembly floor in the manner shown in Fig. 3.

A front and rear axle, each on its "dollie," are placed in position on the assembly floor and the frame lowered to them by means of a hoist on an overhead track, Fig. 4. The spring bolts which attach the springs to the frame are placed and the assembly is pushed down the line on the "dollies" which brought the axles to the assembly floor.

At the next station, the transmission and motor are placed in position and bolted to the frame, as shown in Fig. 5. The motors are fitted with magneto, carbureter, spark plugs, wiring, clutch and propeller-shaft flange in the factory's motor-assembly department in another building, and brought to the truck-assembly floor on specially constructed trucks as shown in the illustration.

The control set, pedal assembly, gear shift rods and brake rods are attached at the next station, followed by the steering gear and radiator as shown in Fig. 6. This completes the assembly of the mechanical units

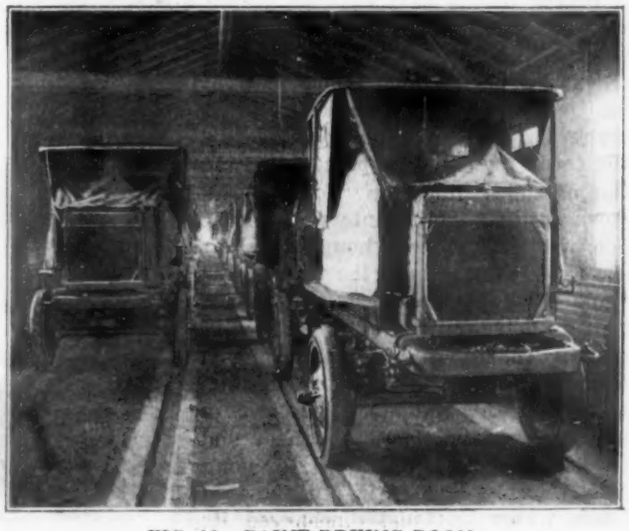


FIG. 12. PAINT-DRYING ROOM

AUTOMOTIVE CONSTRUCTION

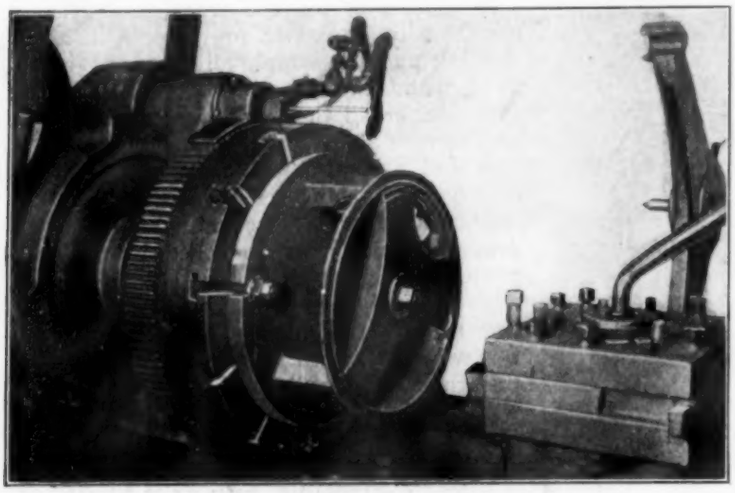


FIG. 13. MACHINING THE CLUTCH HOUSING—FIRST OPERATION

and the seat platform with the seat attached is mounted and bolted in place at the next station, Fig. 7.

This seat platform is assembled from previously cut lumber on the assembling fixture shown in Figs. 8 and 9. The platform is held together by being bolted to various irons made from angle and bar stock. These are formed to templets in the forge shop and drilled for the bolts in the machine shop, coming to the assembly jig in the body-building department, ready to set on the jig and have the boards clamped in position as shown in Fig. 8. The fixture is then revolved on trunnions, Fig. 9, so as to bring the holes in the irons in position where they can be reached and the holes in the boards drilled with electric portable drills. The bolts are placed and tightened and the platform is lifted from the fixture and another one started. Two men on a fixture assemble 25 to 30 platforms in a day of eight hours.

The trimmed seats are then attached, the assembled unit trucked to the paint spray booth and, when dry, to the assembly floor to be placed on the chassis. Electric transportation trucks are used for trucking from one building to another, thus saving much hand labor.

After the seat platform is bolted in place, the truck is moved to the next position where oil, gasoline and water are supplied and the motor started. Up until this last move, the truck has been handled on the "dollies" which carried the axles. As the truck is pulled to this position by the truck immediately preceding it in the assembly line, the "dollies" run down a slight incline into slots in the floor which are deep enough to allow the axles to pass over the tops of the "dollies" as the tires rest on the floor. This discharges the "dollies" at a point just in front of the elevator on which they are placed and sent to the axle-fitting on the the next floor, where another axle is placed on them and they again start on the trip along the assembly line. Fig. 10 shows a truck which has just discharged its "dollies," and is on its own wheels for the first time.

The trucks are fitted with tops over the drivers' seat and then driven onto a turntable, turned through an angle of 90 deg., which brings them in line with the door, through which they pass out to the road-test department on the opposite side of the street.

The trucks are assigned in order to the members of the road-testing crew who "put them over the road" in an effort to find any hidden flaws or careless and imperfect work. A view of the headquarters of this department is shown in Fig. 11. After the trucks have been passed by both the National and the Government inspectors, they go to the wash-stand which is equipped with hot and cold water, steam and gasoline washing devices. From this room they move into a spray booth where the final coat of paint is applied and they are then stored in the room shown in Fig. 12, until they are dry enough to run into the open.

Fig. 13 is a view of a Gisholt turret lathe fitted with tools for machining the clutch housing, first operation. A fixture attached to the spindle of the lathe has three posts against which the casting is held by the triangular spider. The joint face and the male pilot, which fit the rear end of the motor crank case, are finished using forged tools in the cross-slide turret.

The next operation is shown set up on a Davis turret lathe in Fig. 14. In this operation the bearing bore, shaft clearance bore, and outside face are roughed, using the combination tool with inserted teeth, shown at *A* in the front of the illustration. The next bar *B*, shown to the right, finishes these three surfaces, using double-end cutters. The next bar *C* is placed through the finished bore and a flat-facing cutter is inserted by passing it through the hand hole in the top side of the casting. By pulling back on the turret the inside face of the casting is finished so as to give the proper clearance for the clutch-actuating parts.

Fig. 15 is an illustration of the fixture used to mill the spring shackles which are of the conventional type, a rough-forging *A* and a finished piece *B* being shown

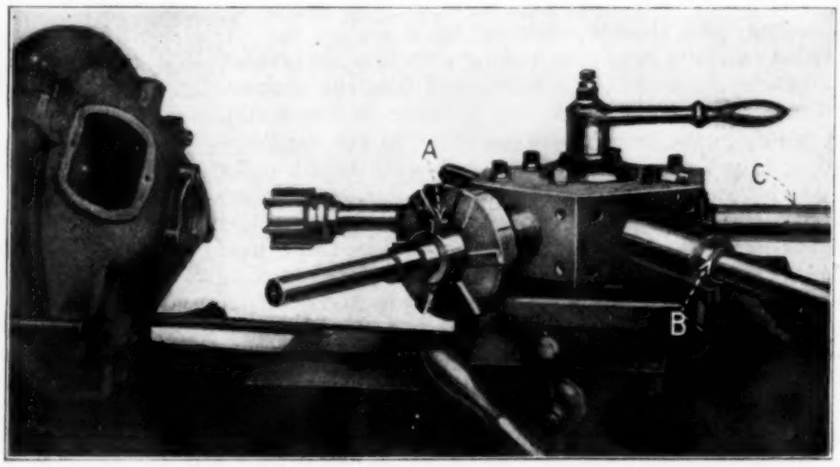


FIG. 14. TURRET LATHE OPERATIONS ON THE CLUTCH HOUSING

AUTOMOTIVE CONSTRUCTION

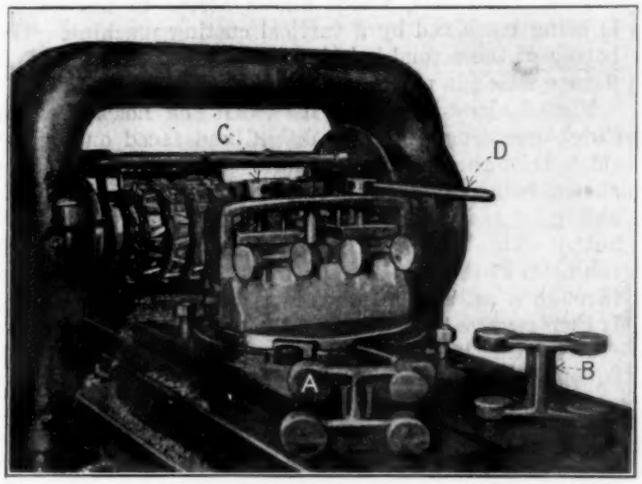


FIG. 15. MILLING SPRING SHACKLES

in front. The two ends of the shackles are identical as regards the milling which permits of them being milled in this indexing fixture. Two forgings are held side by side, being clamped with the round-headed screws *C* operated with a pin handle *D*. Two of these fixtures are used, one each side of the cutters. As the cut is finished on one end of the forgings, the table is traversed to bring the forgings in the opposite fixture up to the cutters and they are machined while the first set is being indexed for their second cut, or replaced with rough-forgings if need be. The two fixtures are located on the table so as to require the least travel possible which gives practically a continuous milling set-up.

Two Drill Jigs for Motor-Truck Work

By I. B. Rich

One of the pieces to be drilled, a part of the clutch, is shown at the lower right-hand corner of Fig. 1, and it will readily be seen how this slips into one of the four openings of the drill jig as shown at *D*. The plate *A* fits on the two guide posts *BB* and it is lifted off to put the pieces in place and to remove them after being drilled. This plate carries 12 bushings.

The projection *C* on the work slips into the opening *D* while the slot goes over the ears *E* and *F* of the slide

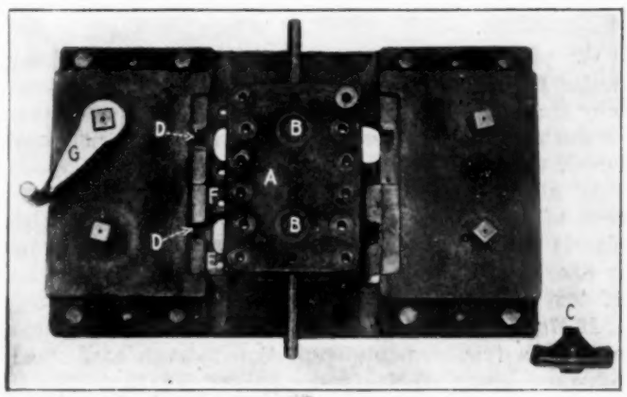


FIG. 1. DRILL JIG FOR CLUTCH BOSS

which prevents the drill pressure from closing them during the operation. Then the work and its holder are moved forward under the holes in the drilling bushings by means of the handle *G* which can be applied to any one of the four square studs shown.

In Fig. 2 is shown a five-station rotary drill jig for drilling the small end of the brake-shaft levers shown in foreground. The hub of the lever fits over one of the central studs *A* while the outer end is centered by the V-blocks *B*, controlled by the cam *C*. The two sets of stubs enable the same fixture to handle two different

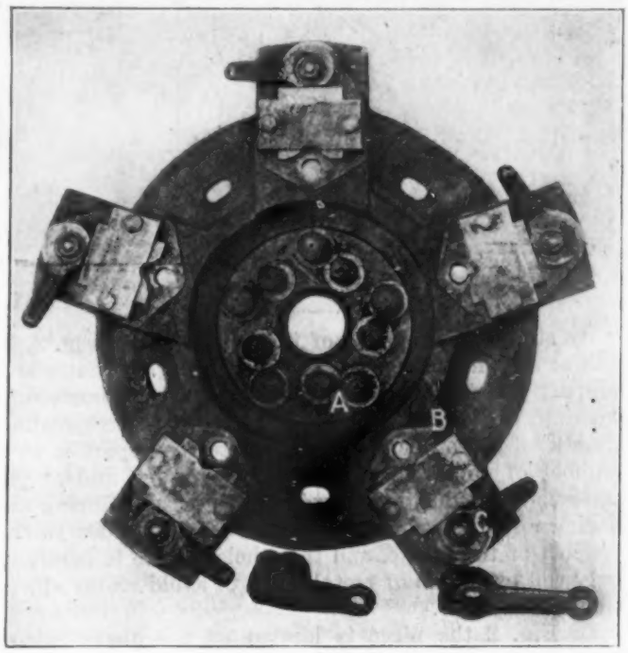


FIG. 2. A STATION-TYPE DRILL JIG

sizes of levers, and as a two-spindle Baker drilling machine is used, it allows the drilling and reaming of holes at the same time. The fixture is rotated from one station to the next, which makes the operation continuous.

Bearing in mind that this is for comparatively small production, it will readily be seen that numerous modifications can be made so that it may be applied to a variety of work. These tools are in use in the shops of the Autocar Co., Ardmore, Pennsylvania.

Boring and Milling Transmission Housings

By Fred H. Colvin

The methods used by the Chandler Motor Car Co., Cleveland, Ohio, in machining its transmission housing, are illustrated in Figs. 1, 2 and 3. In Fig. 1, which shows the initial operation, the fixture is bolted to the face of a substantial chuck and utilizes the chuck jaws for holding the inner end of the casting, while the fixture itself centers and supports the outer end. The central hole and the large outer flange of the aluminum casting are machined in this operation, the hole and the flange being used for locating the piece during future operations.

AUTOMOTIVE CONSTRUCTION

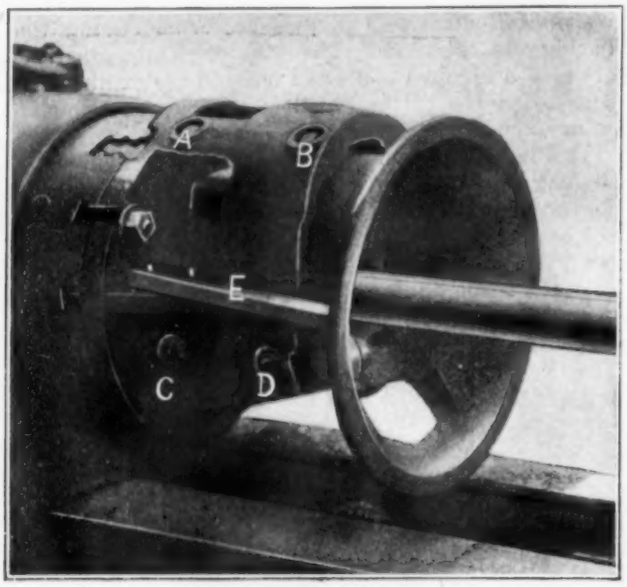


FIG. 1. FIXTURE FOR BORING HOUSING

By studying the shape of the casting from Fig. 2, it will be seen how the screws *A* and *B*, Fig. 1, center and support the casting each side of the upper horizontal opening, while screws *C* and *D*, matching corresponding screws on the other side of the fixture, support it at a number of points so as to avoid springing, and at the same time provide sufficient hold for driving during the boring and facing operations. The bar *E* adds to the support of the flange, and the whole fixture is carefully balanced by blocks of metal so as to avoid undue vibration in the lathe.

In Fig. 2 the piece is located on the angle fixture by the flange which has already been faced, while the angular hand hole, which allows access to the clutch, is being machined by a vertical cutting machine. The boring of the second hole is accomplished with an offset fixture which is not illustrated.

FIG. 2. MILLING HAND-HOLE OPENING

Fig. 3 shows the way in which the holes for the clutch-operating shaft are drilled and faced on the inside. Here the housing is mounted in the special fixture shown, being centered through the main hole by a suitable pilot and clamped in position by the C-washer and nut *A*. This locates it in proper position so as to have the holes at the right angle, and the first hole is drilled through a suitable bushing in the fixture. The fixture is then revolved 180 deg. and the opposite hole drilled.

After this the holes are line-reamed straight through so as to correct any slight inequality in alignment and

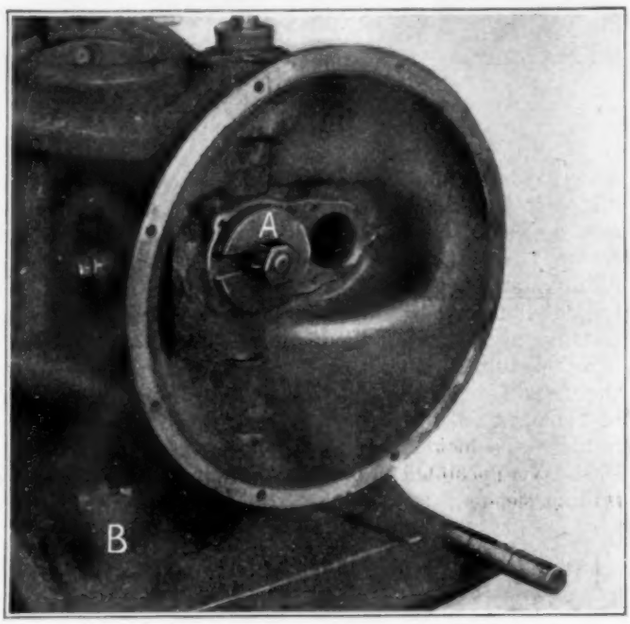


FIG. 3. BORING HOLE FOR CONTROL SHAFT

the inner ends of the bosses are surfaced by the double-ended cutter shown at *B*. This is mounted on a plain bar, held in position by a pin, and the ends back-faced in the usual way. While such shaped pieces are somewhat awkward to handle, the illustrations indicate how a little ingenuity overcomes all such handicaps.

Stamping the Size on Mandrels

By John A. Grill

On page 278 of *American Machinist* E. M. Long, under the title "What's in a Name?" wants to know why manufacturers of lathe mandrels do not mark their product on the small end so that a workman may know which way it is to be put into the work.

In all my experience I have observed that, in the case of mandrels regularly made for the market, the size is stamped on the *large* end. I know that Brown & Sharpe and other large manufacturers of this class of tool follow this practice.

If Mr. Long will familiarize himself with this common custom, a few moments' reflection in each case should convince him that it is the other end that goes in first.

Notices and Claims Under Compensation Acts—I

By CHESLA C. SHERLOCK

This is the first of three articles dealing with the technicalities incident to the reporting of accidents and the obtaining of compensation under the compensation acts. The necessity for prompt notification in case of accident is brought out in some detail.

EMPLOYERS who have been following the growth of the workmen's compensation acts and the decisions of the courts relating thereto have probably been surprised to note the growing tendency on the part of the authorities to lay more stress upon the technicalities of the law than has been true in the past.

When the compensation system was in its infancy, slight stress was laid upon the technical demands of the law. If a workman failed to present his claim in the proper manner or was a little slow in presenting it at all, the tendency was to resolve the doubt in the favor of the employee and proceed to apply compensation benefits anyway.

While this was the early tendency of the compensation commissions no such broad thought is to be found in the more recent decisions handed down by the courts which have had occasion to review these decisions. The courts have taken a firm stand in favor of a strict construction of the technical provisions of the compensation acts, and they have, consequently, had a tendency to bring the commissions up sharp.

The compensation acts, without exception, contain provisions making it necessary for the injured workman to give notice of his injury or of any accident that may occur in the course of his employment, within a certain specified length of time. While the statutes in the respective states do not agree as to what this length of time shall be, the majority of them provide that the notice of the accident must be filed with the employer within 30 days from the time it occurred.

While there may or may not be reasons for thus arbitrarily fixing a limitation upon the time in which an employee can file notice of an accident or injury, that is not for us or the courts to discuss. It is a legislative move which can be considered only as it is given to us.

The legislative authority evidently had it in mind to encourage the early report of accidents in order to make it as easy as possible for the employer to inform himself as to the facts surrounding them, and not permit employees to delay the matter or the question of the employer's liability until such time as suited their whims or made it more convenient for them to press their demands. Witnesses are often tampered with and sometimes lost sight of, and unless the employer has an equal chance to ascertain the facts as soon after the accident as possible, he is being put at a disadvantage which cannot be too strongly emphasized. Then, again, it is manifestly unfair to keep employers in a state of suspense and unrest as to their actual liability under the compensation acts. The compensation acts sought to fix a liability upon each employer, so certain and definite that he could insure his risk thereunder in some insurance carrier.

In a New York case decided last year it was stated in the footnote by the court: "The provision of the New York Workmen's Compensation Act providing for written notice of injury to be given by an employee within 10 days after disability must be complied with by giving prompt service of the notice in order that the employer may have an opportunity to investigate the circumstances of the claim." Also, ". . . it must be presumed that the opportunity for prompt investigation by the employer is one of value."

It is presumed that where a workman has failed to comply with this provision of the compensation acts, he has thereby prejudiced the rights of the employer. The claim is not completely barred, although it will be necessary for the injured workman to sustain the burden of proof in court and show that his failure did not, in fact, prejudice his employer's rights. If he is unable to make this showing then his right to compensation for injury is lost.

Beginning of Limitation Period

The greatest difficulty under these acts, however, is to determine whether the time commences to run from the date of the accident or from the date of the disability, these two often being separated by a lapse of time, although the disability is due to the original accident. There is only one way to settle this and other questions arising upon this phase of the compensation acts, and that is by a careful examination of the decisions of the courts which have been called upon to render decisions covering it. And in this connection it is well to keep in mind that the decisions mentioned in this discussion are of very recent origin. All have been decided within the past year, unless otherwise expressly stated.

In an Indiana case it was shown that the workman sustained a hernia in June, 1916, but that he continued at work, with the aid of a truss, until January, 1917, when he was forced to give up work. On Feb. 7, 1917, he gave the statutory notice of injury and on March 19, 1917, he made formal application for compensation. The court held that under the circumstances the injury did not develop until January, 1917, and that the proper notice was given within 30 days.

In a California decision handed down in 1917 it was pointed out that where notice has been given of an injury and compensation paid, but that later greater disability arises from the same injury, it is not necessary to give a new notice. All that the law requires is notice of the original injury.

As to the sufficiency of the notice to be given, the Texas court held that the phrase "as soon as practicable" does not mean as soon as possible, "the word 'practicable' importing a difference according to the circumstances, and meaning ordinarily that the thing must be done as soon as reasonably can be expected."

In a Michigan case the injured workman did not report his injury to the employer, and the only person to whom he mentioned it was to one who was subordinate to him in the employer's factory. Said the court: "It appears that the deceased mentioned his alleged injury to two employees of the defendant; one, the witness Kelleher, 1½ days after the alleged accident; and the other, the witness Bennett, in the summer or fall following.

It appears that Kelleher was not an officer of the company nor a proper person to whom to report the injury. The testimony is conclusive that he was working under the deceased, who was acting as yard conductor, and, being a subordinate employee, notice to him cannot be held to be notice to the company. . . . In reference to the witness Bennett, it appears that he was a general yardmaster, and conceding for the purpose of this case that he was a proper person to whom to report of an injury should be made, the record seems to be undisputed that no report of the injury as such was ever made to him, and the only knowledge he had thereof was the result of a casual conversation with the deceased."

This is to the effect that an oral communication of the fact of injury is not sufficient compliance with the law.

In Michigan the statute provides that "no proceedings for compensation for an injury under this act shall be maintained, unless a notice of the injury shall have been given the employer three months after the happening thereof." The law also provides that claims for compensation must be made within six months after the occurrence of the injury, but if the claimant is physically or mentally incapacitated, within six months after the removal thereof. It was claimed by the claimant that following the injury he was physically incapacitated from giving notice, and that as soon as the incapacity was removed the notice was given.

Notice of Accident Must Be Given

The court held that the expression in the statute relating to incapacity related to filing a claim for compensation and that it had no application to the duty to give notice of the injury received. This is a distinction that should be kept in mind by all employers. The duty to give notice of the accident or injury is paramount to everything else; the duty to bring a claim for compensation can be allowed to wait, depending upon the circumstances, but that is not true in the first instance.

In a New York case the workman, while working alone, injured his hand with a tack. He continued work for several days, when an infection set in and it was necessary to perform several operations on his arm. He did not give written notice of the accident until two months after the operations were performed.

The Industrial Commission held that the employer was not prejudiced by this failure to give the notice "for the reason that there was no one present when the accident occurred, and therefore the employer could obtain no affirmance or denial of the fact of the accident, and for further reason that as soon as evidence of infection appeared, Hynes was under the care and attention of a duly authorized medical practitioner."

The court reversed a decision of the appellate division affirming this decision, saying: "The logic of the commission seems to be as follows: Because the claimant tells the truth as to his accident; because no one was present to contradict him; because later blood poisoning developed and developed as a result of the injury; because a licensed physician attended him who was presumably competent—no investigation could have been useful to the employer.

"This is reasoning in a circle. Notice and consequent chance of investigation is given for the very purpose of enabling the employer to test the good faith of the claimant. Without it no contradiction is possible. If many are present at the time of the alleged accident; if their stories agree; if there is no doubt of the injury and its results—there may be a basis of the finding that lack of notice did no harm. But assume that the injury was so slight as not to cause attention at the time; that no physician was called for 11 days; that the accident is remembered only after the lapse of six or perhaps 13 days; that blood poisoning may result from any slight prick, any scratch, any bite of an insect, then the absence of witnesses would seem to require rather than to excuse notice."

Wherever in law it is required that notice be served upon another, the question always arises as to whether it is necessary to give such notice when the other party has knowledge of the fact already, or has been placed in such circumstances that he cannot help having prior knowledge of it. This question of "knowledge and notice" is one that has caused a great deal of discussion in the courts and it even crops out in the compensation acts.

In a Massachusetts case decided in 1917 it was held that oral notice given by an employee of an injury to his employer cannot be said to constitute knowledge on the part of the employer which would obviate the giving of written notice of injury as required by the compensation act. In another case decided by the same court in the same year it was held that such knowledge as would excuse the giving of written notice of an injury must have been acquired within the time when written notice should have been given; that is, "as soon as practicable."

In a Nebraska case it was held that where the employer admits that he knew of the injury and the death of the employee the necessity of giving notice thereof is obviated.

In another Massachusetts case it was shown that the employer had rendered a report of the accident to the proper authorities. The court said: "The fact that a report of the injury was made by the employer is amply sufficient to warrant a finding that the subscriber had knowledge of the injury in accordance with the act."

Foreman Presumed to Be Owner's Agent

In a Maine case it was held that if a foreman who has complete superintendence of the men has knowledge of the injury that it obviates the necessity of a written notice to the employer, the foreman being presumed to be the "agent" of the latter. The court said: "The decision of the commission does not, we think, carefully distinguish between findings of fact and rehearsals of evidence, nor between notice and knowledge. Knowledge is not the notice required by the statute. Oral notice is not the statutory notice and although the employer may obtain it from the former knowledge of the injury, it is not necessarily knowledge within the meaning of the statute. We conclude, however, that the decision contains sufficient to show that the commission finds that the foreman, Penwarden, had seasonable knowledge of the injury, and that the discussion as to notice may be separated from such finding and treated as reflections by the way."

In a Texas case it was held that verbal notice given to a foreman within two or three days after the injury was sufficient notice within the meaning of the act and satisfied the provision regarding notice.

In an Indiana case the court said: "The knowledge of the foreman under whose direct and immediate supervision appellee worked from day to day must be regarded as the imputed knowledge of the employer, and for the

greater reason the knowledge of the superintendent of the factory who had general supervision of the plant must be held to be the imputed knowledge of the corporation. No other construction can be made to harmonize with the manifest legislative intent as revealed by the statute itself."

In a New York case the commission held in a case where notice had not been given within 10 days, as required by the statute, that the employer was not prejudiced because the factory superintendent had heard of the injury within 10 days. The court refused to sustain this finding, declaring that it made oral notice equivalent to the written notice the statute requires.

It is fairly well settled that where the failure to give notice within the time specified by the statute has not prejudiced the employer, it will not be fatal to the right to compensation, especially where it was not due to any effort to mislead or deceive the employer.

A case was recently decided in Wisconsin where it was shown that the workman was employed in a camp some 10 miles from town and that he received an injury which later caused his death. His wife had to walk back and forth to town for supplies and medical aid and during the interval mailed two letters to the employer. These, however, were not mailed until the expiration of the statutory period. Since it was shown that no effort had been made to mislead the employer and that he had not in fact been misled or prejudiced in his rights, the court sustained the finding of the commission awarding compensation.

The whole question of notice of an accident or injury to be given to an employer has been pretty well covered by these decisions, which should point out to employers that they are acquiring some definite rights under these later decisions of the courts that it may pay them to examine carefully. The time limit set upon the filing of notice of accident or injury is not, in any sense, an effort to cut any workman off from the just benefits of the compensation act to which he might be entitled, for the courts even now will extend the mantle of protection afforded to him when so doing does not in any way alter the employer's rights.

The time limit is in the nature of a miniature statute of limitations which is put there for the protection of the employer and which seeks to confine his liability to a given, definite point of time. No employer can be entirely uncertain, under such circumstances, as to just what his liability under the compensation acts may be, for the limitation is constantly either extinguishing or bringing to light, within its period, evidences of his liability.

Employers, however, who attempt to use this safeguard fraudulently or to take advantage of their workmen who may not know about it will receive no sympathy at the hands of the court. It is not there for that purpose; it is there for the purpose of focusing the employer's liability.

Employers should be very plain and explicit to their employees, making it especially emphatic that all accidents must be promptly reported and notices of injury given as soon as practicable after the injury occurs. If workmen know that any dilatory tactics on their part will extinguish their rights to compensation, they will make prompt reports and this will aid the employer in getting the facts quickly and make for a speedier settlement all around, which is one of the basic reasons for the existence of the compensation acts.

We have found, then:

1. That the provision of the statutes relating to notice of accidents or injuries received must be substantially complied with.

2. That oral notice may be sufficient, if communicated to the employer or to some one standing in a representative capacity, but it is always wise to make the notice in writing, as is required in New York.

3. That while knowledge may be notice, it is not to be trusted and the statute should be complied with in spite of it.

Pipe Dreams of a Tramp Machinist—English as She Is Spelled

By Glen Quharity

One day, some time after electric lights had become common at Brookdell, a shop order made out in due form came to the desk of Tom Jones, the master mechanic, to "repair 1 leight."

The order bore the signature of a comparatively new foreman in one of our manufacturing departments which was housed in an outlying building away on the other side of the shop yard and across the brook. Tom had put his official O.K. on the order and sent it by shop mail to Bill Shailer, the engineer who was the immediate boss of everything electrical around the plant.

Next day the same order reappeared on Tom's desk, O.K. and all. Tom scratched his head and wondered if he had dreamed about that order yesterday; then he sent it back to Bill. Next day the same order turned up again in Tom's mail box, and this time Tom is worried. He grabs the telephone, gets Bill on the wire and roars "S'matter'd'ju, you ole fat head? I sent you Van Dorn's order to fix a light and it's come back three times. Don't you fellers know how to fix a 'lectric light?"

"Ain't nothin' the matter with no light over there," says Bill. "I sent a man over three times and he can't find no trouble."

"Aw'rite!" says Tom, as he hangs up the 'phone and pushes a button for a boy. The bell was promptly answered by a junior cub from the machine shop, just outside of which Tom's office was located, and when the boy appeared Tom handed him the order and said: "Take that order to Van Dorn, make him show you the light and tell you what's the matter with it."

The boy disappeared with the order and in due time returned, saluted respectfully and said: "Mr. Jones, I am disappointed in you. I had supposed that you possessed a superior education, and I find you falling down on a simple example in orthography."

"No son," Tom confessed rather sadly, "I never had much schooling. When I was a kid the schools were not what they are now, and we boys had to get out and hustle at an age when you fellows are mooning over a desk in the high schools. What have I done now?"

"It's my duty," said the boy solemnly, "to inform you that l-e-i-g-h-t spells *lathe*."

"The h—l you say!" roared Tom, as the boy vanished quickly through the machine-shop door to avoid being hit by anything that might happen to be following him.

Tom changed the order to conform to his own crude notions of spelling and dispatched it to the machine shop with the request that the junior cub be sent to make the repair.

Modern Aviation Engines—II

By K. H. CONDIT
Managing Editor, *American Machinist*

IN this installment of airplane engine sketches we are showing the engines of the more conventional type about which the French aviation program was built. At the beginning of the war France was about as well equipped with aviation material as any of the belligerents, but at that time very little was necessary to hold one's own in this field. The engines, however, were of the rotary type which had been successful on account of their lightness and in spite of their unreliability.

There was little to choose between the antagonists until the Germans brought out the fast Fokker pursuit machine which showed promise, for a while, of driving the Allies out of the air. The emergency was met by the appearance of the first Hispano-Suiza aircraft engine designed by the Swiss engineer, Marc Birkigt, and built by the makers of Hispano-Suiza automobiles whose factories were in Barcelona and Paris. These motors were built in a number of models both for land and seaplane work but they achieved fame in combination with the famous Spad single-seater fighters which were designed for them in time to turn the tables on the Fokkers. A later model in the British SE5 was equally successful.

The same basic principles appear in each of the many models. The aluminum crank case is made in two halves, the crankshaft being held in four plain bearings and one radial ball bearing, the lower halves of the plain bearings coming away with the lower half of the case. The tubular connecting-rods are of the forked type, and in the latest American models are fitted with detachable bronze boxes of the marine type, a much more satisfactory job in many ways than the original. The cylinders are steel sleeves with closed tops, except for the valve seats, and screw into aluminum water-jacket blocks on the top of which are the camshafts. The cams act directly on the ends of the valve stems which are hollow and fitted with mushroom-headed adjusting screws. The first model, A, was rated at 150 hp. at 1450 r.p.m. and made the reputation of the line. It was later re-designed and became the model I with a slight increase in power. An increase in revolutions per minute and compression ratio brought the horsepower to 180. This is the present model E high-compression, or "pussé" Hispano, used in the later Spads and SE5's.

The 300-hp. model H shown here was developed later and showed great possibilities although it did not really get into production. It is essentially the same as the other models mentioned but with greater dimensions. The first of these motors was brought over from France during the winter of 1917-18 and was practically re-designed at the Wright-Martin factory. One of the first motors turned out by them was used by Major Schroeder when he broke the world's altitude record at Wilbur Wright Field with a Bristol Fighter in October, 1918. The motor was fitted with special high-compression pistons for this flight.

The "300" Hispano was also used in the Loening monoplane which was tested just before the armistice and gave a performance which placed it ahead of any plane of its type then in existence.

These four models were the only ones put in production in this country as the geared-down motors did not find favor with our aëronautical engineers. In France, however, several geared models were produced which gave good service in both land and sea service. Most of them incorporated the machine-gun barrel above the crank case and in line with the propeller hub center and one even mounted a 37-mm. cannon. Several tandem combinations of the different sizes were also experimented with.

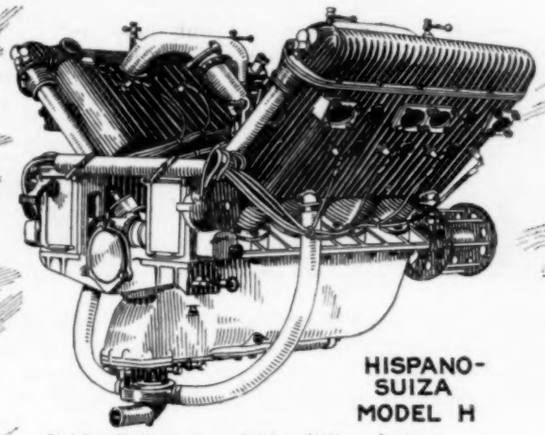
At the beginning of the war, Renault had an air-cooled V-type engine which was soon relegated to service in training planes where it gave admirable service. It was largely used by the British for the same purpose under the name RAF. The Renault engineers soon developed 12-cylinder, V-type engines of the water-cooled type in 300- and 400-hp. models, the 300 going into large production for use in reconnaisance and day-bombing machines of the Breguet type.

These motors were very different from the Hispano-Suizas as their cylinders were individual forgings with thin steel water jackets similar in general design to those used on the Liberty, Rolls-Royce, Benz, Mercedes, and Fiat engines. The overhead camshafts operated the valves through rocker-arms instead of directly and the carburetors were located outside instead of within the V. The 300-hp. model had a cylinder-block angle of 47 deg. instead of the normal 60 deg. for 12-cylinder engines, a device also used in the Liberty to reduce engine width and head resistance. Four six-cylinder magnetos were mounted between the cylinder blocks, each firing six plugs on one side of the engine. This arrangement provided the necessary two sparks per cylinder and made possible the use of standard magnetos to fire cylinders firing at uneven intervals.

The Lorraine-Dietrich engine, a 12-cylinder model, was considered by many experts the best of the French engines although it did not get into production until rather late in the war. This engine followed our practice in using battery-generator ignition and was in many respects much like the Liberty 12. The normal angle between cylinder banks, 60 deg., was adhered to, however. At the time when we were faced with the problem of choosing a combat engine of high power, only two engines were considered, this one and the English Rolls-Royce. The Lorraine-Dietrich had not yet been proved, however, and the Rolls did not lend itself to American production methods. As a result the Liberty program was started.

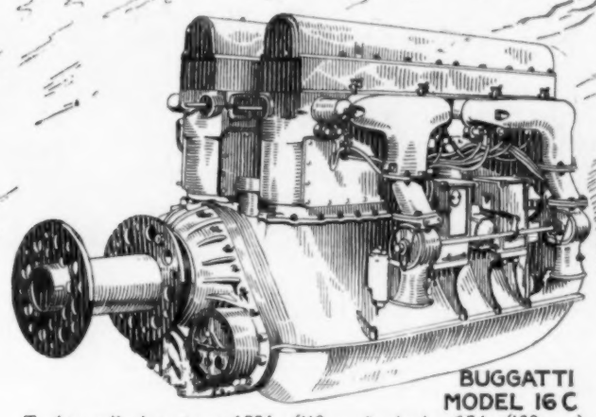
The only other high-powered engine attempted was the other engine shown. We have sketched the American development of this motor which was designed in France by Ettore Bugatti and built first as a vertical eight with a geared propeller shaft at the side of the crank case. As this model did not develop sufficient power, another row of eight vertical cylinders was placed beside the others and both crankshafts were geared to the same hollow propeller shaft.

When this motor was brought over here it promptly broke down under test and had to be entirely redesigned. It was just going into production when the armistice was signed.



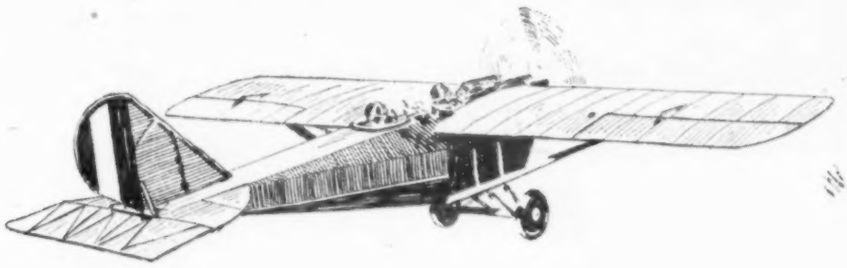
HISPANO-SUIZA MODEL H

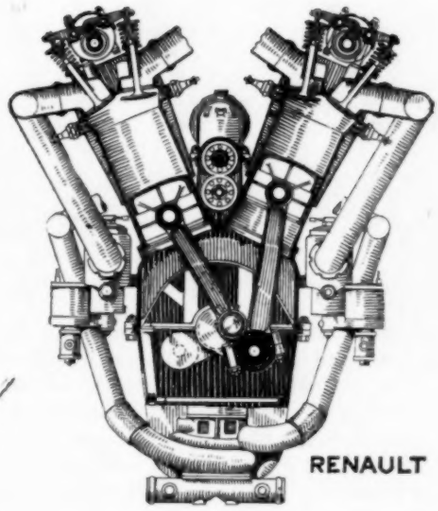
Eight cylinders; bore, 5.511 in. (140 mm); stroke, 5.095 in. (150 mm); compression ratio, 5.3 to 1; rated hp., 300 at 1800 r.p.m.; magneto ignition; dry weight per hp., 1.66 lb.; fuel consumption, 0.53 lb. per b. hp.-hr.



BUGGATTI MODEL 16 C

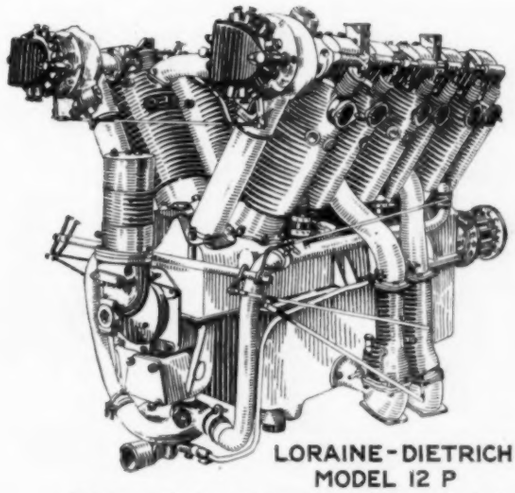
Twelve cylinders; bore, 4.33 in. (110 mm.); stroke, 6.3 in. (160 mm.); compression ratio, 5 to 1; rated hp., 420 at 1950 r.p.m.; magneto ignition; dry weight per hp., 2.14 lb.; fuel consumption, 0.54 lb. per b. hp.-hr.





RENAULT

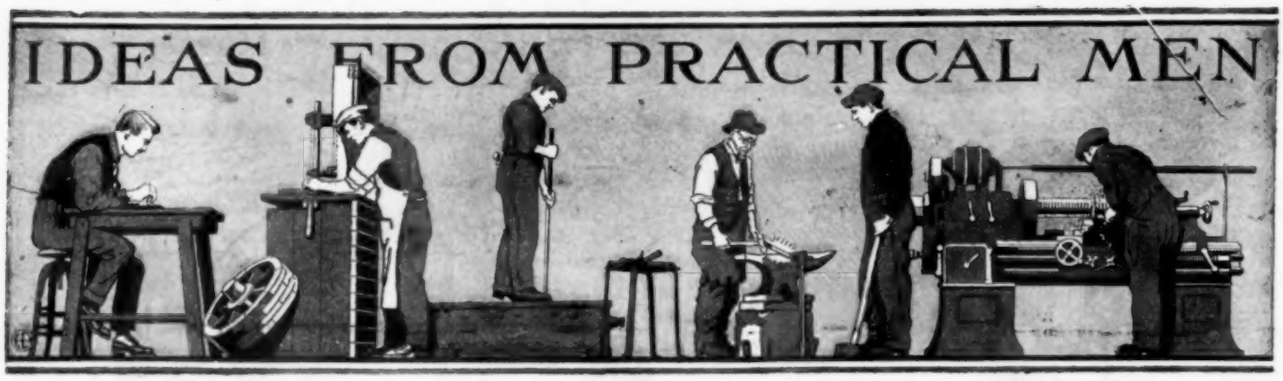
Twelve cylinders; bore, 5.11 in. (130 mm.); stroke, 5.51 in. (140 mm.); rated hp., 400 at 2080 r.p.m., magneto ignition; dry weight per hp., 2.05 lb., fuel consumption, 0.55 lb. per b. hp.-hr.



LORAINE-DIETRICH MODEL 12 P

Twelve cylinders; bore, 4.72 in. (125 mm.); stroke, 6.69 in. (170 mm.) rated hp., 370 at 1650 r.p.m.; magneto or generator-battery ignition; dry weight per hp., 2.08 lb.; fuel consumption, 0.55 lb. per b. hp.-hr.

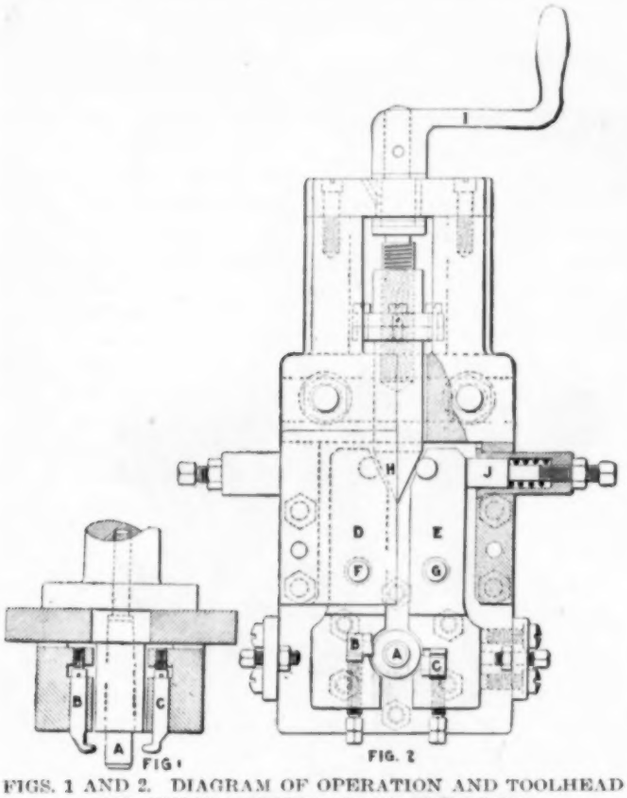
-by B. Z. REITER-



Toolhead for Undercutting

By Frank C. Hudson

The design of the Liberty motor cylinder calls for the undercutting of the spark-plug boss and the tool for doing this is shown herewith. Fig. 1 is a diagram of the way the tool works, while Fig. 2 gives a good idea of the construction of the whole toolhead. The pilot *A* and the two tools *B* and *C* are shown in both figures. The tools *B* and *C* are held in the toolholders *D* and *E* which are pivoted at *F* and *G*. These tools are fed into



FIGS. 1 AND 2. DIAGRAM OF OPERATION AND TOOLHEAD FOR UNDERCUTTING SPARK-PLUG BOSS

the work by the cone *H* which is advanced by the handle *I*.

On each side of the holders *D* and *E* are spring plungers, one being shown at *J*. These tend to keep the tools in their position of greatest diameter and insure a steady cut as the cone is fed in between the two toolholders. These plungers also return the tools to their original positions as soon as the cone *H* is withdrawn.

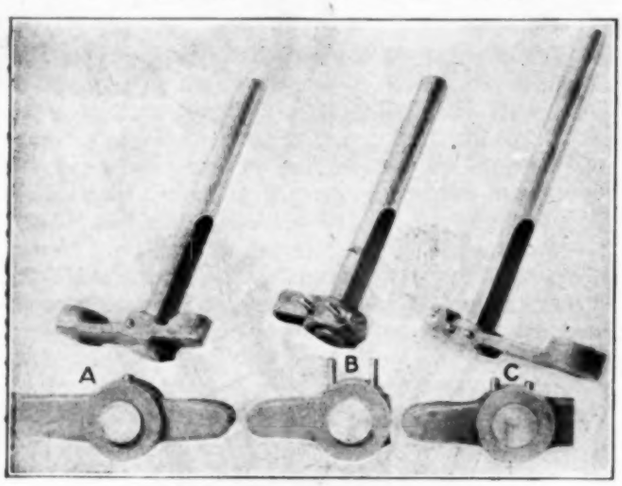
This device was used under an ordinary drilling machine in connection with a substantial mandrel or holder which located the cylinder in the proper position. It will be noted in Fig. 1 that the tools and their holders project far enough from the face of the device to clear all projections on the end of the cylinder head.

Test of Taper-pin Fastenings for Levers

By E. A. Dixie

Nearly forty years ago my old boss said, "The only way to tell how strong a thing is, is to 'bust' it." This is as true today as it was then.

In the construction of a certain machine we had a cast-iron lever secured to a $1\frac{3}{16}$-in. shaft. This lever is supposed to "stay put" in the positive position in which it is assembled with the shaft. Setscrews are



DIFFERENT METHODS OF FASTENING

out of the question, as operators are apt to monkey with setscrews and get the parts out of adjustment.

All kinds of fastenings were discussed in the drafting room, the result of the discussion leaving us satisfied that one or more taper pins properly applied would solve the problem; give us a firmly fixed position for the lever, and also a fastening which could be taken apart or renewed without injury to the parts and yet could not be easily fooled with by the operator.

There was however much divergence of opinion as to whether one or two taper pins should be used and also how the pins should be applied. To settle the matter, we decided to try several methods and "bust them" to see how strong they were.

Three levers were fitted to three $1\frac{3}{16}$-in. shafts as follows: Lever *A* had one No. 6 taper pin fitted (radially) through the center of the shaft. Roughly the area of a No. 6 pin is 0.093 in. Lever *B* had two

No. 4 taper pins (roughly 0.049 in. in area) through it and the shaft. The center distances of the pins was $1\frac{3}{16}$-in.; that is to say, half of each pin was in the shaft and half in the lever. Lever *C* had two No. 4 taper pins through it and the shaft. The center distances of the pins was $1\frac{5}{16}$-in.; that is to say, the pins went through the lever and their *full diameter* through the shaft.

It will be noted that there is a flat on both sides of each of the shafts. These engage a slot in the testing fixture which is made of steel so that there is no chance of failure with it.

The whole outfit—shafts and testing fixture—was sent to the Henry Souther Engineering Co., Hartford, Conn., for test and their report follows:

"The levers were assembled in the fixture supplied and strapped to the table of our testing machine; load was then applied by bringing the traveling head of the machine down on the end of the lever with the following results:

"Sample A—The lever was assembled with No. 6 pin. This lever supported a load of 1,318 lb. when an appreciable yielding was observed. We were shortly able to increase the load to 1,335 lb. which was the maximum the lever would support. Subsequently, this lever was again subjected to loading conditions to determine if the cast-iron lever could be broken. When the second load was carried up to 1,218 lb., the pin sheared completely making it necessary to discontinue the test.

"Sample B—The lever was assembled with two No. 4 pins, $1\frac{3}{16}$ in. apart. This lever was loaded up to 1,154 lb. when the casting broke close to the shaft.

"Sample C—Lever assembled with two No. 4 pins, $1\frac{5}{16}$ in. apart. This lever was loaded up to 1,326 lb., at which point the casting failed through the boss surrounding the shaft."

The test shows conclusively that the two small pins placed tangentially were stronger than the one large pin placed radially. It also shows that the two pins are stronger than the lever castings. As the levers are strong enough for the work imposed upon them, the two pins form a satisfactory method of fastening.

A close examination of the pins after the test showed that only one of the pins in each of the test pieces *B* and *C* carried the bulk of the load. This might have been due to improper fitting or possibly due to stretching of the levers while under test. This would tend to show that *one* of the smaller pins placed tangentially is stronger than the single large pin placed radially. Other tests of pinned fastenings are in contemplation and the results will be given later on.

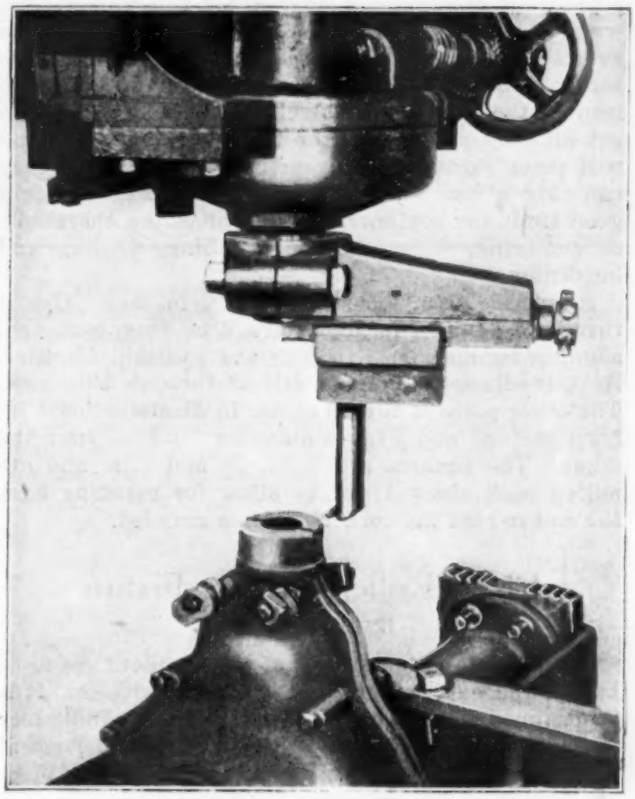
A Handy Boring Head

BY JOHN DREW

Having a lot of work to do which involved boring, facing and turning upon pieces large and awkward to hold such as automobile transmission and differential cases, etc., the boring head shown in the illustration was devised.

Nothing new is claimed for the device; it is shown rather in the hope that as a suggestion it may prove of value to others who may have similar work to do and are in despair because they have no boring mill big enough to handle it.

The construction of the device is obvious from the photograph. The main casting is bored to fit over the spindle of a large radial drilling machine, being held thereto by friction; though if heavy cuts were necessary it could be keyed without especial injury to the spindle. No attempt was made to put a transverse feed on it, as all facing cuts are short and it is an easy matter for the operator to give the knob a twist every time it comes around. All other feeds are, of course, provided by the mechanism of the drilling machine.



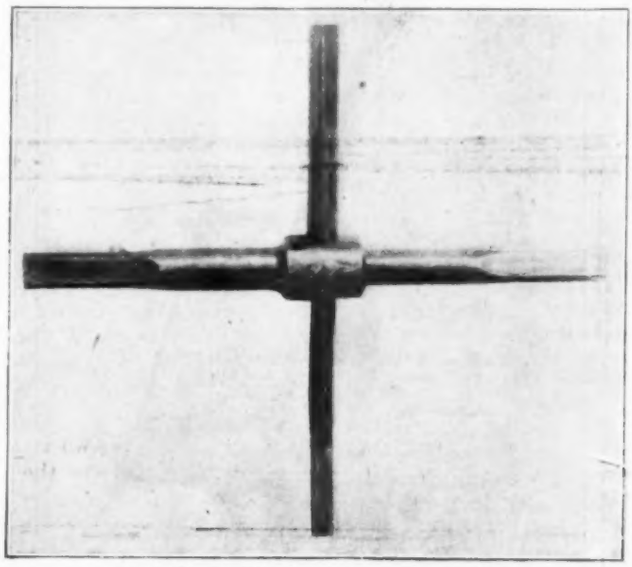
BORING HEAD ON A RADIAL DRILL

Wrench for Safety Setscrews

BY F. J. ATKINS

A handy dog wrench which will fit four sizes of safety setscrews of lathe dogs is shown in the illustration.

This type of wrench is a novel idea for a vocational



WRENCH FOR SAFETY SETSCREWS

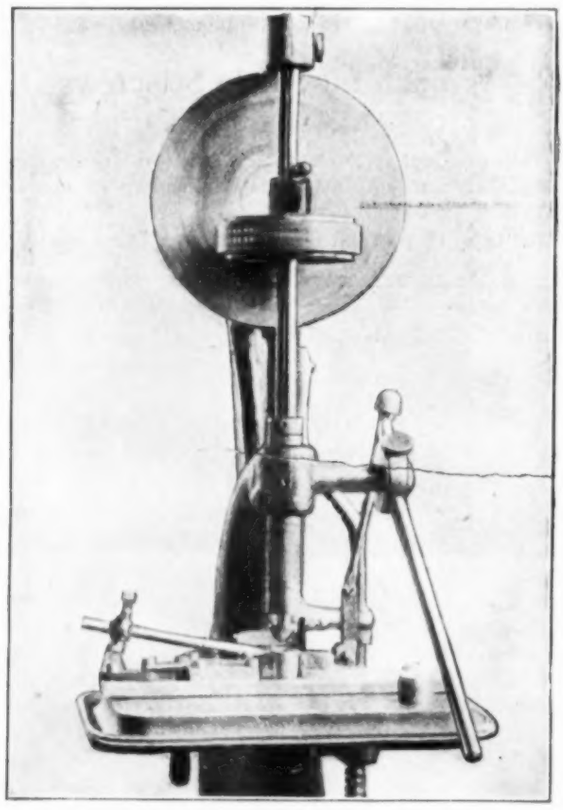
school. It eliminates a search for the proper-sized wrench, usually the last one to be picked up; it also averts the grinding of a larger one to fit a small set-screw, which is a common occurence, especially by men in the evening-school classes who are eager to get all they can out of the two hours of work, and will resort to almost any method if they think they can save a few minutes. This wrench also makes a good study for beginners as it involves the operations of centering, facing, turning, milling, drilling and hardening.

It is made from tool-steel pieces 7 in. long. One is turned to $\frac{1}{2}$- and $\frac{5}{8}$-in. diameters, 3 in. from each end, allowing for a center 1 in. long and $\frac{15}{16}$ in. in diameter. A $\frac{7}{16}$-in.-diameter hole is drilled through this part. The other piece is turned $\frac{7}{16}$ in. in diameter for 4 in. from one end and $\frac{3}{8}$ in. in diameter for 3 in. from the other. The squares are $\frac{5}{16}$, $\frac{3}{8}$, $\frac{7}{16}$ and $\frac{1}{2}$ in. and are milled back about $1\frac{1}{2}$ in. to allow for grinding back the end in case the corners become rounded.

Chain Roller Burring Fixture

By W. H. Addis

Wherever large quantities of small rollers are to be burred the fixture shown will prove profitable. It is so designed that the operator controls the spindle feed and clamps the work in position with one movement of the right hand, leaving the left hand free to place the rollers in the fixture. A connecting-rod is fastened by a ball-and-socket joint to the hand lever. The other end of this connecting-rod is attached by a yoke to a bell-crank lever, which in turn is attached to another connecting-rod and lever which causes a sliding V-block to move forward and grip the work as the feed lever is pulled down. Each connection is adjustable which permits the gripping action to be so timed that when the roller is firmly gripped the burring tool will have just enough downward movement to perform its work and then stop. This fixture works very rapidly and permits large quantities of work to be burred in a short time; the same idea might also be adapted to the work of countersinking and spot-facing.

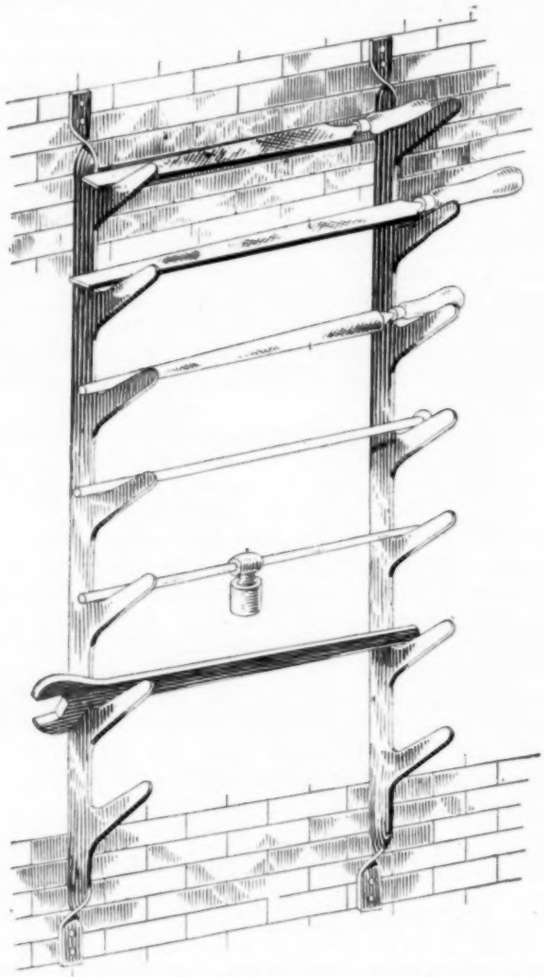


CHAIN ROLLER BURRING FIXTURE

Handy Tool Rack for the Wall

By John Vincent

Many work benches are provided with drawers in which the workman throws all tools indiscriminately, and then, when he wishes to find a certain tool, he has to search through the pile. This method is pretty hard on tools, particularly files. To avoid such occurrences and provide a convenient rack for supporting tools wanted for momentary service, the Minneapolis Threshing Machine Co. has constructed a large number of racks similar to the one shown in the accompanying illustration. These racks are cut out of galvanized sheet steel and have horns projecting at convenient distances to take care of the tools which will be placed on them. The upper and lower ends are given a twist and bent flush with the wall, to which they are usually nailed if of wooden construction, or screwed into wooden plugs when the wall is brick.



WALL TOOL RACK FOR USE OVER WORK BENCHES

What Leaders in the Electrical Field Think of the Compulsory Metric System

St. Louis, Feb. 23, 1920

Ethan Viall, Editor,
American Machinist.
Dear Sir:

Answering your letter of the 18th with reference to the proposed bill in Congress, making the metric system compulsory: our engineers and shopmen are fundamentally opposed to any such proposition, and at the proper time will co-operate in writing our representative in Congress against lending support to any such measure.

I am not in a position to advise you just what the financial result in our business would be, were such a measure to be adopted—which of course would be difficult to estimate.

The proposal seems so preposterous that I can not imagine the measure meeting with success.

Yours very truly,
Wagner Electric Manufacturing Co.,
W. A. LAYMAN,
President.

West Lynn, Mass., Feb. 25, 1920.

Ethan Viall, Editor,
American Machinist.
Dear Sir:

Anyone advocating the compulsory use of the metric system is simply crazy. There is enough trouble running business today without upsetting it further.

Very truly yours,
Massachusetts Electric Manufacturing Co.

Detroit, Feb. 13, 1920.

American Machinist.
Attention Ethan Viall, Editor
Gentlemen:

We are in receipt of your favor of Jan. 23, in regard to the Legislation now pending in Congress to make the metric system compulsory.

We wish to say that if this thing goes through, it will be nothing more or less than a calamity to this country. We are not in favor of the metric system and we do not know of anybody that is. We are having sufficient troubles at the present time without taking on any new ones in the shape of a metric system.

Such a law would not only cost many millions of dollars, but could never be enforced. It would result in nothing but confusion. Under these circumstances we are emphatically against it, and trust that Congress will never be so foolish as to pass a law of this kind.

Very truly yours,
American Electrical Heater Co.,
F. KUHN,
/ice President.

Warren, Ohio, Feb. 24, 1920.

American Machinist.
Attention Ethan Viall, Editor
Gentlemen:

Acknowledging yours of the 16th, we thank you indeed for advising that Congressman Vestal, of Indiana, is expected to introduce in a few days a bill making compulsory the use of the metric system. This system should most assuredly not be made compulsory. Aside from the cost of gages, jigs, scales, micrometers, etc., it would mean a large investment (difficult to calculate) and would result in untold confusion due to the necessity of educating our employees to the new standards.

At a conservative figure, it would mean at least an expense of $50,000 to this company with no resultant advantages so far as we can foresee.

We will be appreciative of the summarization of the replies which we judge you are requesting from various other manufacturers.

It is our opinion that this proposed bill should be submitted to the League of Nations, and then submarined enroute.

Yours very truly,
The Peerless Electric Company,
W. C. WARD,
Vice President and General Manager.

Cleveland, Feb. 19, 1920.

Ethan Viall, Editor,
American Machinist.
Dear Sir:

We have been watching the metric propaganda for some time and are genuinely alarmed at the progress of such a radical idea. **If we were to get together and plot with our Bolsheviki and Communists to strike an appalling blow to American industry, we would need to go no further than adopt the metric system. Nothing we can do would help our Hun friends more toward boosting their export trade.** In our own plant here we would have to change about everything but the factory building, and the cost to the nation's manufacturing would look like several Liberty Loans.

Due to shortages of labor and material, the average manufacturing plant is having troubles enough these days without changing its entire system of measuring. The writer wishes to go on record as being absolutely opposed to the metric system, and trusts that Congress will see that our best interests are taken care of by rejecting the metric propaganda in part, or as a whole.

Yours very truly,
Electric Vacuum Cleaner Company, Inc.,
CHARLES F. QUEISSER,
Factory Superintendent.

Ansonia, Conn., Feb. 18, 1920.

American Machinist.
Attention: Editor
Gentlemen:

This will acknowledge your letter of the 16th inst., calling attention to proposed action of Congressman Vestal, of Indiana, Chairman of the Committee of Coinage, Weights and Measures, that he is to introduce a bill in a few days making the use of the metric system compulsory.

We are, very much, opposed to the metric system. We hope it will never be made compulsory. We do not see that it has any advantage over the English system. Our business would be upset considerably if we were compelled to use it. With regard to what the change would cost us we could not say definitely. We feel sure, however, that it would be quite large. It would tend to reduce our production quite a good deal.

Very truly yours,
The Cameron Electrical Manufacturing Co.,
J. B. DAVIDSON,
Vice President and General Manager.
Plainville, Conn., Feb. 21, 1920.

Cincinnati, O., Feb. 24, 1920.

American Machinist.

Attention Ethan Viall, Editor

Dear Sir:

Replying to yours of the 18th, the compulsory adoption of the metric system would cause the utmost confusion in our factory.

It is difficult to place any figure on the additional cost, but it is safe to say that it would be a matter of years for the business to absorb it.

Yours very truly,
The Triumph Electric Company,
J. C. HOBART,
President.

Howell, Mich., Feb. 23, 1920.

Ethan Viall,
American Machinist.

Dear Sir:

Acknowledging receipt of your letter of February 16th, please note that we should object very seriously to the metric system being made compulsory. As our plant is comparatively small it would mean a serious upset in our business. It would mean a great deal of confusion in matching up metric and United States standard sizes during the change over period, and in the final analysis would mean a considerable loss in stock which could not be matched up. I estimate it would increase our manufacturing costs for some time, and with very little question would cause us an expenditure of $25,000 to $30,000 in changes in tools, fixtures, gages, etc.

We therefore believe, particularly at the present minute with the costs of manufacturing products soaring as they are and with the desirability of our lowering these costs rather than the contrary, that this is no time to permit theoretical changes to affect the general situation, and particularly where there is any likelihood of these changes increasing costs.

Yours very truly,
Howell Electric Motors Co.,
J. M. BARR,
General Manager.

American Machinist.

Attention Ethan Viall, Editor

Gentlemen:

In reply to your letter of Feb. 18th, we thank you for the opportunity of expressing our opinion in reference to making use of the metric system compulsory, referred to in your letter of Feb. 18th.

We believe it should not be made compulsory as it would certainly be a radical change in American standard of weights and measures and would cause a tremendous expense to change drawings, measuring instruments, catalogs, etc. that would be required if it was put into effect.

It would also cause countless errors due to lack of knowledge of the metric system, at least until it became generally known.

It would not be at all surprising if considerable pressure is brought to bear on this measure because of its effect on foreign trade, but we should regret very much indeed to see it be made compulsory.

Very truly yours,
The Trumbull Electric Manufacturing Co.,
S. S. GUILLIM,
Secretary.

Others Who Are Against the Proposed Compulsory Metric Law

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.,
East Pittsburgh, Pa.
Per E. M. Herr, President.

EMERSON ELECTRIC MANUFACTURING CO.,
St. Louis, Mo.
Per H. I. Finch,
Vice President and Superintendent.

BENJAMIN ELECTRIC MANUFACTURING CO.,
Chicago, Ill.
Per P. A. Bowers, Advertising Manager.

MECHANICAL APPLIANCE CO.,
(A. C. and D. C. Motors).
Milwaukee, Wis.
Per R. G. Kellog, Vice President.

WESTON ELECTRICAL INSTRUMENT CO.,
Waverly Park,
New Jersey.

CHICAGO FUSE MANUFACTURING CO.,
Chicago, Ill.
Per. G. W. Borst, Electrical Engineer.

GENERAL ELECTRIC CO.,
Pittsfield, Mass.
Per A. B. Hendricks, Jr.,
Engineer, Transformer Development.

INDUSTRIAL CONTROLLER CO.,
Milwaukee, Wis.
Per H. L. Van Valkenburg,
Chief Engineer.

CUTLER-HAMMER MANUFACTURING CO.,
Milwaukee, Wis.

EDITORIALS

Our Interest in the Railroads

ALTHOUGH the builders of machinery of various kinds are not directly interested either in railroads or in their operation, it takes but a little consideration to show that we all depend so much upon transportation for everything we eat, wear or use, that railroads and railroad management should become the concern of all. And the whole situation is far from pleasing or assuring in any way.

We must lay aside all prejudices and look at the situation as it really is, regardless of partisan affiliation or preconceived notions of any kind. With almost no exception the railroads of the country need locomotives, rolling stock, road-bed betterments and machine-shop equipment. The present equipment is being run to the limit of its endurance, and when repairs are finally made they are very heavy, take time and cost money; and the power available is too often inadequate to haul the coal, the farm produce or the manufactured articles which we all need. This adds to the high cost of living all along the line.

One method of management is to allot a certain monthly budget to each division and to each department. In one division headquarters, recently visited, the actual expenditures for the month were $11,000 in excess of the $48,000 allowed by the budget. And this merely kept the motive power in workable condition.

The management of a Southern road last year reduced the working force to a large extent as soon as the winter season was over. The summer force could barely keep the reduced equipment in running condition. And when the working force was finally increased it was too late to get all the motive power back in good condition. The question of management looms large in the railroad world, and there are too few shining examples to which we can point with pride.

Of course, the fashionable and obvious thing is to blame it all on the Railroad Administration—and far be it from us to attempt to shield them from the criticism which they undoubtedly deserve. But when we know that practically all of the conditions named existed before the war, that they are not of recent origin, we are not helping to find a solution by merely crying for a return of the railroads. If these methods existed before—and we know they did—what reason have we to expect them to be changed for the better now by merely restoring them to their former systems of mismanagement?

What the railroads need, and what the country needs, is the kind of management which is applied to other large industrial undertakings. The steel companies do not let their machinery deteriorate in order to show low operating costs. Neither does any machine builder or other business man. They know that next year's profits depend on this year's expenditure in keeping the machinery in good condition.

The railroad managers themselves also know it as well as any of us. But they are not free to manage as their judgment dictates. They are usually expected, or ordered, to curtail expenses so as to make a certain showing in the annual report, not for the ultimate good of the railroad but for its effect upon the stock market.

New railroad-shop equipment is sadly needed all over the country. Recent visits were made to railroad shops at division terminals where the newest machine was twenty years old, and from that they ran back to the vintage of 1870. The sizes of the locomotives have increased and there are more of them on the division, but no new equipment has been ordered in from ten to twenty years—which can hardly be blamed on the Railroad Administration. The machine-shop equipment needed by the railroad shops would keep the machine-tool shops busy for a year at least.

All this means that there is not enough transportation facilities to get produce to market, to carry coal from the mines to the consumer, and it all adds to the cost of living and of doing business.

Then, too, we have the question of salaries for executives, as in nearly all other lines of work. Those who think that the unrest and discontent is confined to the manual workers or to the members of the various labor organizations, do not appreciate the true conditions as they exist today. The master mechanics of railroads in various parts of the country are far from satisfied with their present remuneration and there is talk of organizing at the June convention to secure what they feel is their due.

Shopmen up to general foremen come under the wage award, and a general foreman gets $300 a month. His master mechanic, with much greater responsibilities, gets but $325 a month, by no means enough for a good executive under our present standards of prices. This situation means that the best men will leave the railroad service and get into other lines which pay better salaries.

The railroads, in common with other industries, have felt the falling off in efficiency which has been too general, even though it may be understandable as being a direct reaction from the excitement and conditions of war. But, as in the case of other industries, there are bright spots which show an increase in production and efficiency in overhauling locomotives.

A chart, recently inspected, contained data covering a period of four years and showed several interesting things. During wage discussions, when strikes or increases were pending, the production dropped, as might be expected. This was also the case when lay-offs were expected. But since the last wage discussion and the award, production had increased in a very satisfactory manner. After all, in common with most of our problems, it gets back to the question of sound management, the same as with industrial plants.

The railroads must have fair play, no matter how former managements have incurred hatred and suspicion. They must have money for rehabilitation and extension from either public or private sources. However it comes or whatever the form of management, we must not lose sight of the part the railroad plays in our private and public life, in our actual existence, as well

as in our business prosperity. And while extending the railroads every assistance they need we must not forget that the public or community nature of their service makes it necessary that we all demand the kind of management which will be of the greatest value to the country as a whole. There are greater opportunities for broad-minded and far-seeing management here than in almost any other line.

The Problem of Cheap Fuel for All Manufacturing

NOW that coal is being mined once more we are apt to drop the subject of fuel from our list of worries. This is, however, short-sighted from every point of view as fuel is the basis of our industries, and costly fuel, from whatever cause, is a menace to low manufacturing costs.

The coal situation in this country, which has been favored with the cheapest fuel in the world, is distinctly bad in several ways. It is not easy to lay one's finger on any one cause which can be blamed for it, for, as in most cases, it is a combination of causes with faults on all sides.

It is freely admitted by those who are authorities on the coal situation that too many mines are inefficiently operated, that too many operators are reactionaries and not well fitted in other ways to handle the big business problems which are being presented. Instead of having a broad, forward-looking and constructive policy they have failed to grasp the situation and have allowed it to be dominated entirely by labor and politicians.

The commission which is now making investigations is not likely to take the time to find facts which the consuming public has a right to know. The public's representation on the board is entirely inadequate and cannot be expected to obtain fair consideration for the consumer. When officials with aspirations for the presidency will play into the hands of either miners or operators, the manufacturers, to whom fuel is the basis of their business, should get together and endeavor to secure a square deal for all consumers.

But aside from this, the users of coal can help the fuel situation by doing what they can to equalize the demand throughout the year. The fluctuations between summer and winter demands for coal make it extremely difficult to mine coal economically. It is this fluctuation which tends to cause lay-offs in summer and gives the miners a basis for some of their claims.

If all machine manufacturers could increase their storage capacity for coal by even ten per cent, it would count up to a total which would be of real help in this problem. Some coals do not store well, but it is possible in most cases to do more in this line than has been done. The mine operators might be induced to store to some extent in summer if railroads could handle the coal in fall and winter. Charging for the handling and storage at a fair rate would be perfectly justified and would give the consumer the option of paying the charge or of storing on his own premises.

Unless something can be done to lessen the seasonal nature of the coal mining industry, labor is bound to be restless at times. Enforced idleness breeds discontent and affects one's attitude toward work at all times, leading to and being largely responsible for demands which are unreasonable under present conditions at least.

Every shop manager knows the difficulty of maintaining efficiency and morale in the working force when it is necessary to lay men off at intervals. Far-sighted managers prefer to build stock, either completed machines or the parts which require the most labor. So far as possible the coal operators should do the same instead of throwing the whole burden of equalizing the demand on the consumer.

But the consumer must aid in this in order to help keep down the cost of his fuel in years to come. He must anticipate his needs so far as possible in order to take all he can during the slack months of the coal trade. Co-operative buying by manufacturers of a given locality might help to regulate the demand and to avoid the peaks and hollows of which the mine operators complain.

This is a question for careful consideration by both mine operators and consumers. Arbitrary actions on either side will only tend to increase the troubles which now exist. They must get together, not only for the good of the coal industry but for all other industries which depend on it for success in low-cost manufacturing. Action must not be put off—it must begin now to prevent mine shutdowns next summer.

Wasting the Other Fellow's Time

ONE of the costs of doing business is the time of representatives of various kinds—salesmen and others. Whenever we waste an hour of their time we add that much to the cost of the product. And every customer, including ourselves, has to help pay for it.

A concrete example will make this clear: The representative of a well-known machine builder was requested to make a call at a plant which meant two hours' train travel. When he arrived the man who wrote him was in conference. After waiting an hour the salesman sent in word asking him to name a time when he could be seen, so that he could make another call and come back. The only answer was that he must wait until he was ready to see him.

Another hour and this was repeated. After waiting four hours the conferee came out and told the salesman what he knew at first—that they had decided the day before that they could not wait for his firm's delivery.

Four perfectly good hours were wasted without reason or excuse. Whether we consider the sensibilities of the salesman or not, his firm had four hours of time, plus two hours of railroad time and travel, to add to its overhead—and everyone who buys their machines helps pay for it. It must go into their selling cost.

Every time we waste a traveling man's time, the chances are some one else is wasting time for one of our men in the same way. Not only business courtesy but business efficiency and common sense demand that we eliminate these unnecessary wastes.

The seller is just as important as the buyer and deserves the same consideration in every way. It is generally possible to see men promptly, as we can usually take the time at one time as well as another. The idea that it impresses a man with our importance to keep him waiting is an exploded fallacy. The biggest and busiest men are not the hardest to see nor do they keep people waiting unnecessarily. A little more consideration of the other fellow's time and a realization that all waste adds to the cost of doing business will help us all.

SHOP EQUIPMENT NEWS

– Edited By –
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED CLIPPING INDEX
A continuous record of modern designs • and equipment •

The General Electric Automatic Welding Machine

The General Electric Company, Schenectady, N. Y., has brought out an automatic arc welding machine for use with the regular welding set, but designed to take the place of the hand-controlled electrode. It consists of a pair of feed rolls driven by a small direct-current motor, which draws in and delivers to the arc a steady supply of wire and automatically maintains the best working distance. The whole is controlled from a small panel.

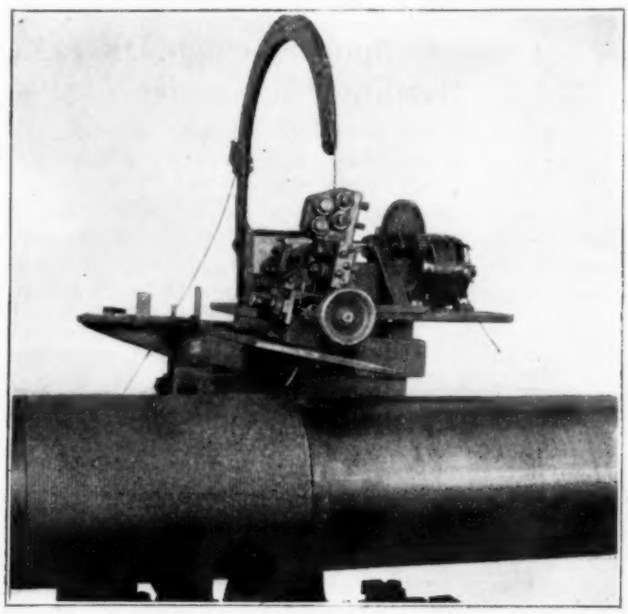
The welding nead is held by a suitable support, and carries feed rolls and straightening rolls which are both adjustable for various sizes of wire. The arm is supported on a gear box, together with the motor. This box contains gears which give three gear ratios, thus extending the range of the device while allowing the motor to operate at its most favorable speed.

The control panel carries an ammeter and voltmeter for the welding circuit, as well as rheostats, a control relay, and the contactors and switches for the feed motor. It is possible to start and stop the equipment from the work by a pendant push button, but adjustment of the feed conditions must be made from the panel.

The adjustment for arc conditions by regulation of the speed of the feed motor, as the arc voltage varies, is taken care of by the panel equipment. It is claimed that the result is a practically steady arc.

The whole apparatus is mounted on a base which can be bolted to any form of support. Thus a great variety of working conditions can be met, but provision must be made for carrying the arc at uniform speed along the weld. For instance, for straight seams, a lathe or planer bed may be used, and for circular ones, a lathe or boring mill.

The device is intended for use where a large amount of routine welding is to be done, and is said to be capable of from two to six times the speed possible by skilled operators and to give a uniform weld of improved quality. It is adaptable to welding seams of tanks and plates, rebuilding worn or inaccurately turned shafts (as shown in the illustration), rebuilding worn treads and flanges of wheels, and many other kinds of work.

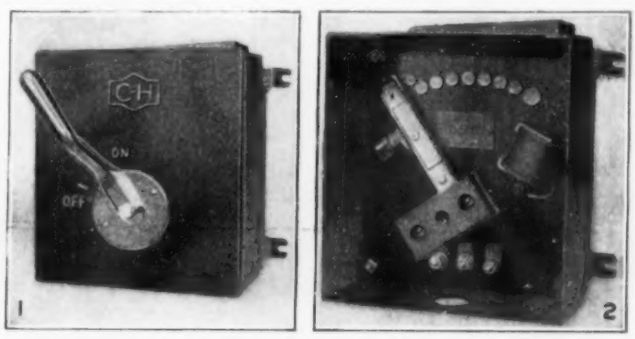


AUTOMATIC WELDING MACHINE BUILDING UP AN UNDERSIZED SHAFT

Inclosed Faceplate Starter for Small Direct-Current Motors

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has added to its line the starter shown in the accompanying illustrations. The inclosed feature removes all danger from exposed parts, and protects the button and segment contacts from damage due to fine collecting dust or spraying water. This starter, known as bulletin 2111, is intended for small direct-current motors in exposed locations, driving line shafts, fans, blowers, pumps, drills and small motor-generating sets for arc welding.

It consists of the familiar type of direct-current hand starter inclosed in a sheet-metal case, having an external lever which engages the movable arm of the starter The external, or operating, lever is insulated from the



FIGS. 1 AND 2. CUTLER-HAMMER INCLOSED STARTER
Fig. 1—Exterior view. Fig. 2—Interior arrangement

revolving contact arm by a block of molded insulation. A pointer on the lever and legends stamped on the cover indicate to the workman whether the starter is "off" or "on." A low-voltage release coil in series with the shunt field protects the motor in case of voltage failure or if the field should be opened while the motor is running. The armature resistor is completely inclosed in the starter case, which is kept well ventilated by a flue in the top. Renewable contacts are provided on all except the smallest starter which has a black insulating composition knob in place of the ordinary operating lever. The inclosing case is arranged for the entrance of conduit from the under side.

The starter is made in various capacities up to 50 hp., operating at 115, 230 and 500 volts.

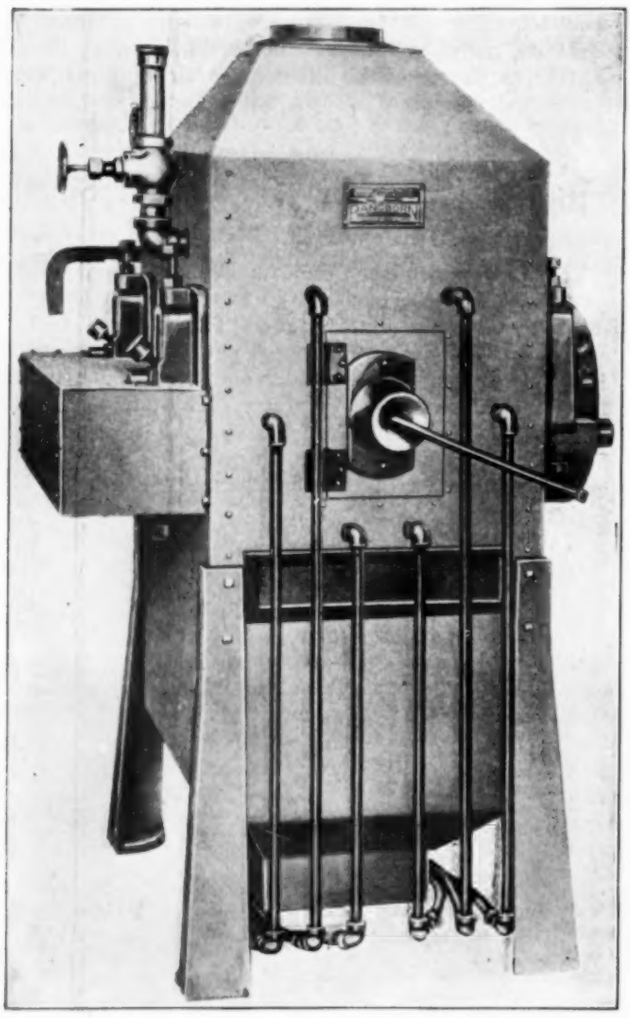
Sandblast Cabinet for Rod Cleaning

The Pangborn Corporation, Hagerstown, Md., has lately placed on the market a cabinet for sandblasting rods of various shapes, ranging from $\frac{3}{8}$ to $\frac{1}{4}$ in. in size.

Rolls and guides at each end of the cabinet provide constant and uniform travel of the rods through the blasting zone, the rolls being shaped to handle the various sizes and shapes of rods to be cleaned.

Six blast projectors are used and the blast stream covers the entire circumference of the rod. The bottom of the cabinet forms a hopper for the storage of abrasives. Individual feed boxes, in plain sight of the operator, supply abrasive to each projector, and connection to an exhaust system provides for the removal of all disintegrated material.

It is claimed that the blasting operation being entirely confined, the cabinet can be safely installed in proximity to machine tools and that the operator does not come in contact with dust-laden air. Either mineral or metal abrasive can be used.

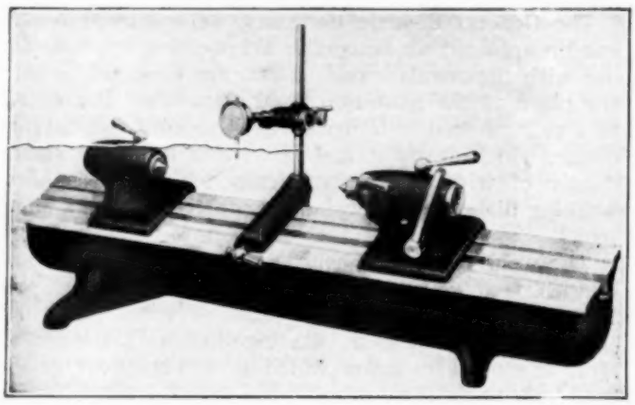


SANDBLAST CABINET FOR ROD CLEANING

American Gauge Co.'s Bench Centers

The American Gauge Co., Dayton, Ohio, has brought out the bench centers illustrated herewith.

The bed is of box section and is supported on three feet. The top face of the bed is inclined, making it impossible to be used as a "catch all" for tools. The construction also facilitates the placing of large-diameter work as it allows plenty of room for the workman's hands.



AMERICAN GAUGE CO.'S BENCH CENTERS

The bench centers are made in two sizes, 6 x 24 in. and 8 x 36 in. They are regularly furnished with a dial indicator reading to 0.001 in. A fine adjustment for setting the indicator is provided.

The Davenport-Slocomb Direct Reading Micrometer

A well-known and thoroughly tried-out counting mechanism has been applied to a micrometer caliper by the J. T. Slocomb Co., Providence, R. I.

The wear-resisting qualities of the caliper are not sacrificed in any way by the addition of the mechanism. The counting wheels and pinions, as may be seen from the illustration, are mounted on an eccentric

DAVENPORT-SLOCOMB DIRECT-READING MICROMETER

barrel which is provided with a clamp screw. This permits the pinions to be thrown into mesh in the same manner as the back gears of a lathe are thrown in, and, of course, allows of a fine adjustment for mesh. The counting wheels are 0.425 in. in diameter and are mounted on a sleeve that runs concentric with the spindle. A keyway and key in the spindle provide means for driving this sleeve and allow 1-in. traverse of the spindle.

The reading is direct on every thousandth and reads from 0 to 999. When the right-hand figure is about central with its aperture, the micrometer reading is correct within 0.0005 in. Where greater refinement is required it is necessary to refer to the nearest line on the thimble and see how it corresponds with the revolution line on the sleeve, but there is no calculating whatever.

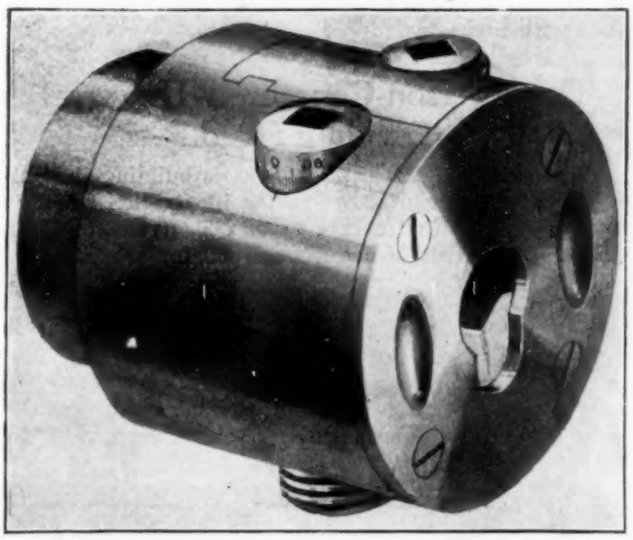
The screw is fifty pitch and there are 20 divisions on the thimble.

The counting device adds but little to the size and weight of the instrument, and as it is about central, the micrometer balances well and may be held and operated by one hand in the usual way. The frame is of drop-forged steel and is finished cold in a hydraulic press at a pressure of 300 tons which compresses the steel and adds greatly to its stiffness. This is important, as it helps the "feel" in measuring and causes the thimble to come readily to a "dead stop," and at the same time allows of a comparatively light frame.

Casler Drill-Chuck Boring-Head

Marvin & Casler Co., Canastota, N. Y., has added to its line the drill-chuck boring-head designated as No. 112 and shown in the illustration.

It is equipped with two screws—one for gripping the drill or boring tool and the other for controlling the offset. The offset screw is graduated to 0.001 inch.



CASLER DRILL-CHUCK BORING-HEAD

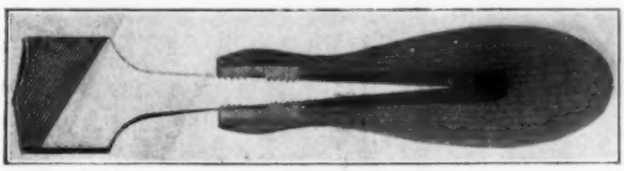
Specifications: Body, diameter 3 in., length 3¾ in.; will take drills from 0 to ¾ in.; will take boring tools from 0 to 9/16 in.; amount of offset with tools up to ¼ in., ½ in.; with tools up to 9/16 in., ¾ in.

After a tool has been gripped by the jaws it can be brought concentric with the body of the chuck by turning the offset screw to the right as far as possible.

"Skroo-Zon" File Handle

Thurston-Bernay Co., Rialto Building, San Francisco, Cal., has placed on the market the file handle shown in the accompanying illustration.

The handle screws on, cutting its own threads by means of two dies contained in a pocket in the handle. The dies are made of hexagon steel, one being smaller than the other, and are so spaced that they accommodate the taper on the file tang. A heavy-steel ferrule is provided to protect the handle from splitting or other injury.



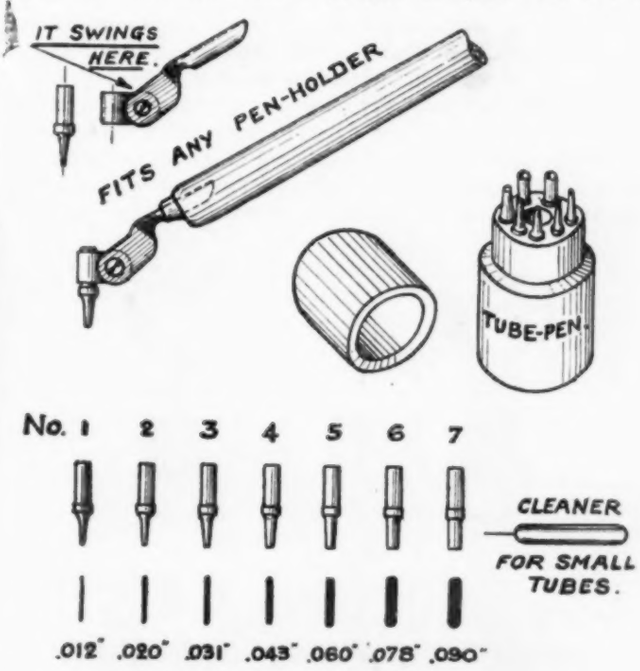
"SKROO-ZON" FILE HANDLE

Handles are made in nine sizes suitable for files from 2 to 16 in. long. The larger sizes are suitable for soldering irons and scrapers as well as for files.

Drawing Tube-Pen

Bourquin & Co., 1345 Main St., Waltham, Mass., has placed on the market the drawing tube-pen illustrated herewith.

As its name implies the pen proper is a tube. For use it is inserted in a swivel socket which in turn can be held in an ordinary writing-pen holder. The tube-pen can be filled with a pipette or quill. In use it should be held perpendicular to the paper, the swivel socket being adjustable to suit the usual position of the hand.



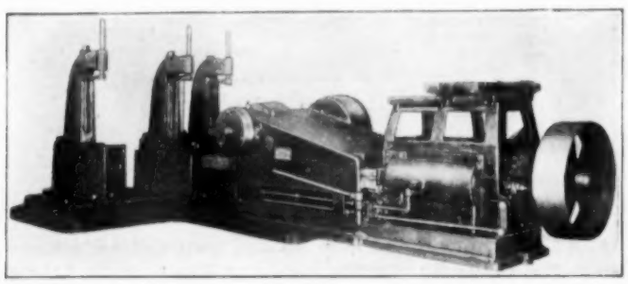
DRAWING TUBE-PEN

Tube-pens are made in seven sizes from 0.012 to 0.090 in. and can be used either for free-hand or ruled work.

Newton U-96 Cold-Saw Cutting-Off Machine

The Newton Machine Tool Works, 23rd and Vine Sts., Philadelphia, Pa., has brought out the cold-saw cutting-off machine illustrated herewith.

The drive is from a belt-connected motor through worm and spur gearing. The wormwheel is bronze,



NEWTON U-96 COLD-SAW CUTTING-OFF MACHINE

Specifications: Saw, 76 in. inserted tooth; capacity, 24 in. at one cut; platen; 60 x 56 in.; V-blocks, 3, fitted with arch clamps; V-blocks will hold work 32 in. in diameter.

and the worm, hardened steel. The worm is provided with roller thrust-bearings.

The feed and rapid traverse mechanism is inclosed with curtain covers and a positive safety release is provided for each extreme position of traverse.

An oil and chip pan is cast on the base to drain lubricant to the reservoir, a loose pan being fitted between the tables for draining to the base pan.

"Klingtite" Lock Washer

The Klingtite Manufacturing Co., 37 Liberty St., New York City, is marketing a line of nutlocking washers of the type shown in Fig. 1. The washer is bell-shaped, with a hole of irregular outline having inward projections. The locking feature is simple; the nut is first screwed tight, and the washer is then clinched in place, by using a short piece of pipe and hammer to flatten it against the nut. This forces the projections further inward, pinching the thread with a tight grip. Instead

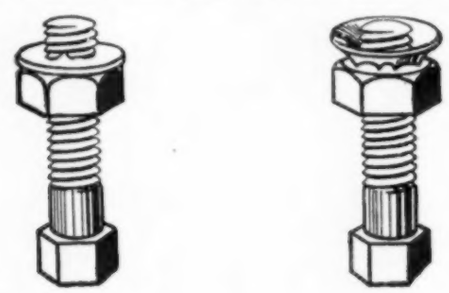


FIG. 1

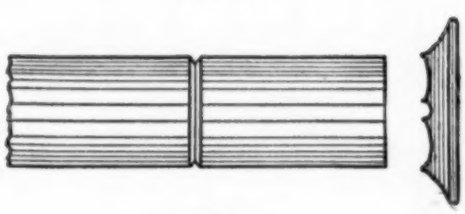


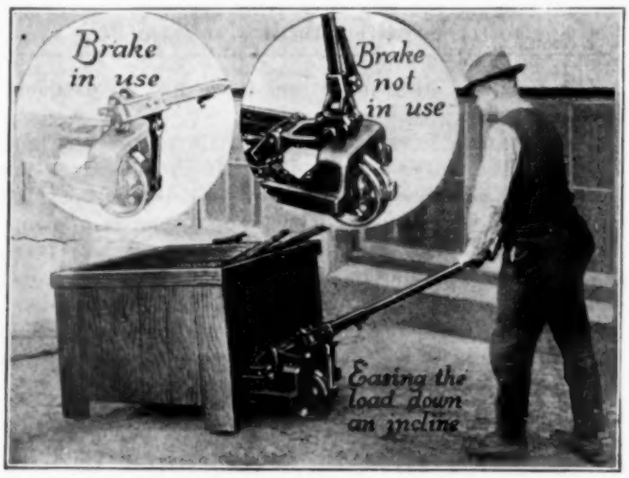
FIG. 2

FIGS. 1 AND 2. "KLINGTITE" LOCK WASHER AND WASHER USED FOR A FLANGE

of a nut lock, the washer may be used to make a flange, or spool end, as shown in Fig. 2. In such a case it would of course be necessary to cut a groove in the shaft that is to be flanged, and then straighten the washer in place by a hammer blow as above described. The washers are made in all standard sizes from $\frac{3}{16}$ to $1\frac{1}{2}$ in.

Brake Attachment for Cowan Transveyors

The Cowan Truck Co., Holyoke, Mass., has brought out a brake attachment for its transveyors. The illustration shows the brake both in and out of action. The brake shoe is normally held from contact with the wheel by

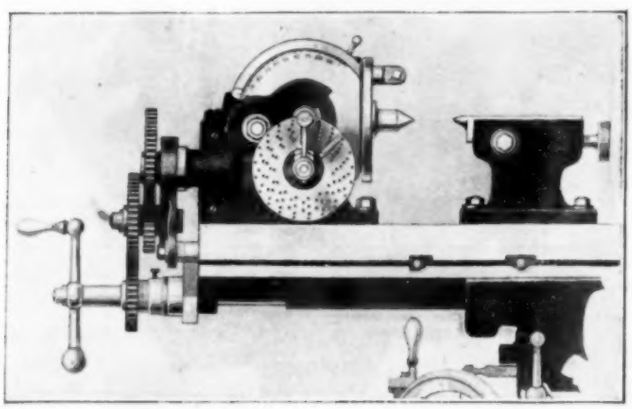


BRAKE ATTACHMENT FOR COWAN TRANSVEYORS

a flat spring. A pendant hooked up to the tongue may be released and dropped into a notch in the lower part of the brake shoe. When in this position, pressing down on the tongue will apply the brake. The brake shoe is lined with raybestos.

The Ryerson-Conradson Universal Dividing Head

The Conradson Machine Tool Co. is building the universal dividing head shown in the illustration which is being placed on the market by Jos. T. Ryerson & Son, Chicago, Ill. This device is designed for exacting ser-



THE RYERSON-CONRADSON UNIVERSAL DIVIDING HEAD

Swing, 14¼ in.; maximum distance between centers on Ryerson-Conradson No. 3 milling machine, 41 in.; combined length of headstock and tailstock, 24¼ in.; hole through spindle, 2⅛ in.; taper hole in spindle, No. 14 B. & S.; faceplate, 8 in. in diameter; weight, 335 lb.

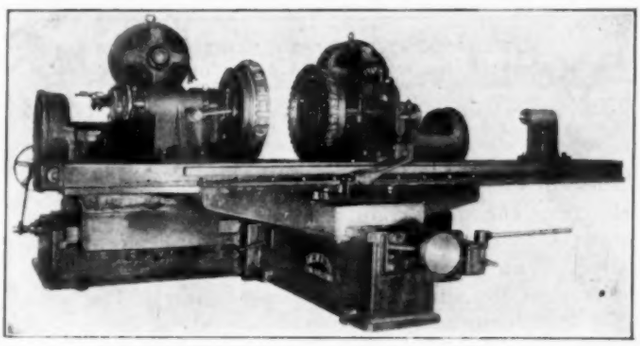
vice and is rigidly built. It has a large wormwheel meshing with a steel worm journaled in large bearings. The steel worm is made in one piece with its shaft, heat-treated and ground to size. Means are provided for disengaging the worm from the spindle and to take up any backlash which may occur from wear. The spindle and faceplate are from one piece of forged steel. The faceplate is 8 in. in diameter and has twenty-four holes for direct indexing and a $\frac{5}{8}$ x $\frac{7}{32}$-in. slot for the driving dog. The centers will swing 14¼ in. The head is graduated and can be clamped in any position from 10 deg. below the horizontal to 10 deg. beyond the perpendicular.

The regular equipment consists of three index plates that will divide all numbers up to fifty and many beyond, wrenches, bolts, driving dogs, and an index table giving all divisions up to 360.

Newton Crankshaft-Cheek Milling Machine

The Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa., has added to its line the crankshaft-cheek milling machine shown in the accompanying illustration.

As its name implies, this machine is intended for milling the cheeks of the throws on crankshafts, an operation usually performed by turning in a lathe.



NEWTON CRANKSHAFT-CHEEK MILLING MACHINE
Specifiations: Maximum distance between centers, 15 ft.; swing, 22 in.; diameter of cutters, 40 in.; distance between cutters, minimum 4 in., maximum 30 in.; number of feeds, six

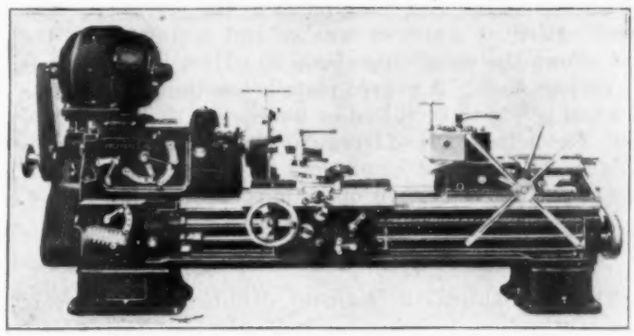
The centers for carrying the crankshaft are movable on the table to accommodate work of varying length. Suitable arch clamps are furnished for holding the work while being milled.

The cutter bodies are steel castings having tool slots machined from the solid. The internal driving gears are integral parts of the cutter bodies. The cutters are driven by individual motors. The work is fed to the cutters by a motor of the interlocking control type so arranged that in the operation of starting the table the two motors for driving the cutters will start before the one operating the table feed. In stopping the table the reverse action occurs.

Cincinnati Geared-Head Lathe

An improved geared-head lathe is being manufactured by the Cincinnati Lathe and Tool Co., Cincinnati, Ohio. The lathe is built in seven sizes, ranging from 16 to 28 in., and is furnished with either single-pulley belt drive, or motor drive through silent chain.

When furnished as a manufacturing lathe, as shown in the illustration, a power feed is supplied for the



CINCINNATI GEARED-HEAD LATHE

turret. A constant-speed motor is used, as all necessary speed variation is obtainable through sliding gears, which provide twelve speed changes in geometrical progression. The gears are positioned by means of the three levers on the front of the headstock, and are so arranged that safety devices are not required. Any lever may be shifted without interfering with the others, and without any danger of locking the gears.

The index plate is easily read and an inexperienced operator is enabled to find the desired speed or feed position without confusion. The gears may be set at neutral, permitting the spindle to be turned by hand, and a control is provided at the apron by which the spindle may be started, stopped or reversed while the power is on.

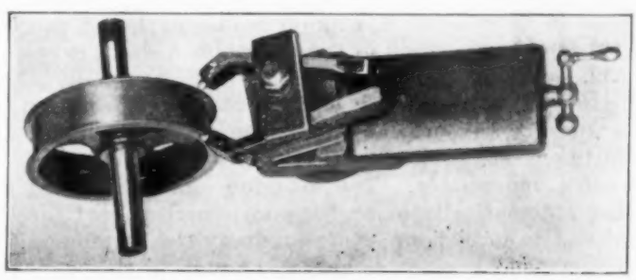
The spindle is forged from high-carbon crucible steel and carries only the face gears and one direct driving gear that is shifted by the center lever. The intermediate shaft has three sliding gears. These are controlled by the right-hand lever and mesh with the back gears. The back-gear shaft carries a pair of sliding gears and three that are fixed.

The drive shaft runs at constant speed and has two sliding gears that engage those on the intermediate shaft. One of these, when in position, furnishes the drive for the lower range of six speeds, while the other, in like manner, drives the six higher speeds. All gears on the back-gear shaft, also the direct-driving gears, are made from steel forgings heat treated; all others are made from high-carbon nickel steel.

The bearings are bronze bushed throughout and are automatically oiled by the splash system, as the gears run in a bath of oil. An indicator is provided that registers the amount of oil in the reservoir.

T. M. B. Double Toolpost

A toolpost of the design illustrated is a product of the Connery Machine & Tool Co., 56 Harrison Ave., Springfield, Mass. The broad, flat base and top clamp furnish a substantial means for holding two tools securely and

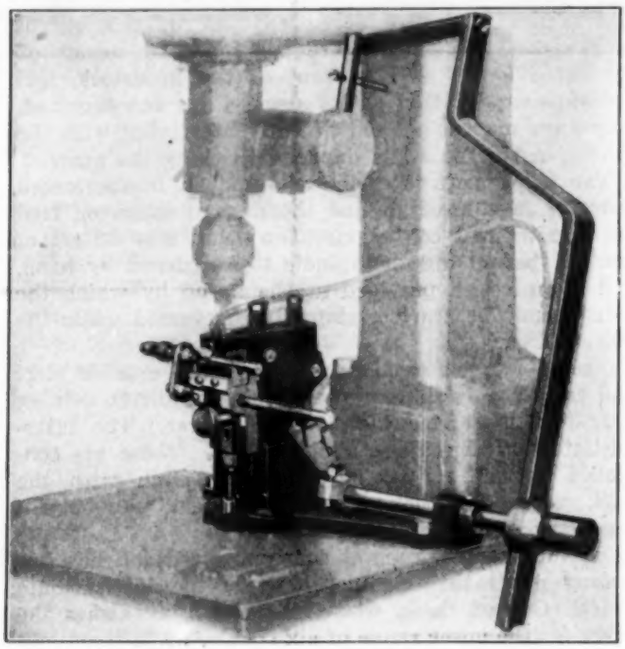


T. M. B. DOUBLE TOOLPOST

at the same time absorbing much of the vibration. The combination of a convex washer and spring under the nut allows the equalizing clamp to adjust itself to tools of various sizes. A curved plate below the base permits the tool points to be raised or lowered in the usual manner. The bolt head is of irregular shape so as to be adaptable to different widths of slots. The toolholder should prove useful for certain operations such as illustrated.

The Adjusto Drilling Jig

The semi-automatic Adjusto drilling jig, shown in the illustration, is being made by the Automatic Drill Tool Co., 549 West Washington Blvd., Chicago, Ill. It is designed to speed production by automatically clamping and ejecting small pieces of work from the jig. The



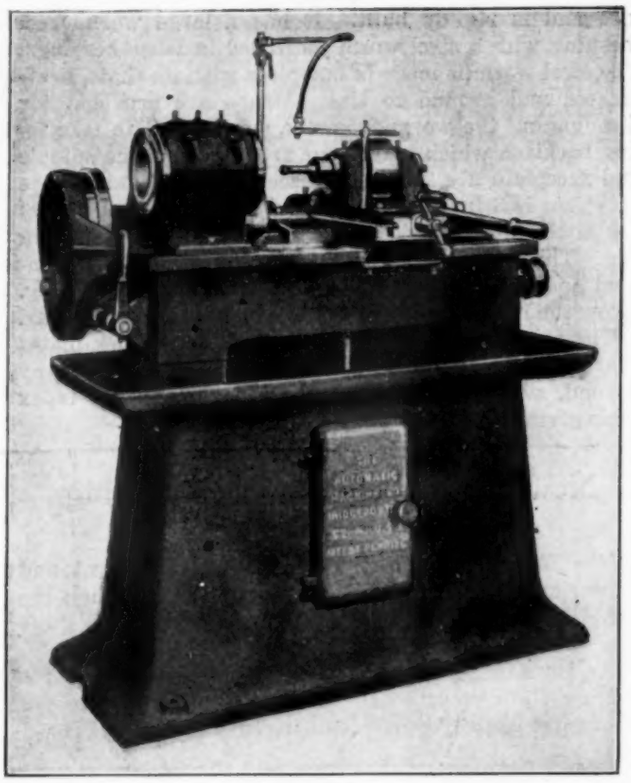
ADJUSTO SEMI-AUTOMATIC DRILLING JIG

device can be set for various sizes of work and for different locations of holes, thus avoiding the building of special jigs for certain classes of work. The device can be easily attached to a high-speed sensitive drilling machine and can be adjusted to take parts up to 1 in. in diameter. It drills up to $\frac{7}{32}$ in., and can be fitted with special holding blocks for odd-shaped pieces.

"Automatic" Thread Milling Machine

The Automatic Machine Co., Bridgeport, Conn., has brought out the thread milling machine shown in the illustration. The machine is of the hob or multiple-cutter type in which the cutter has the form of the thread to be cut but is without lead. A thread can be cut in one revolution of the work plus a slight overtravel.

In duplicate work it is only necessary to set the machine for sizing as, when once set, no further adjustment is required until the wear on the cutter becomes appreciable. The machine can be stopped either automatically or by hand on completion of the work. The only hand operation required is moving the carriage back for clearance in placing the work and re-entering the cutter to the starting position.



"AUTOMATIC" THREAD MILLING MACHINE

Specifications: Swing over bed, 14 ¼ in.; diameter of spindle face, 7⅞ in.; hole in spindle, 4⅛ in.; maximum distance between work and cutter spindles, 14 in.; hole in cutter spindle, No. 9 B. & S. taper; capacity, 6 in. in diameter; floor space, 50 x 24 in.; weight, net 2,000 lb., crated 2,200 lb., boxed for export, 2,525 lb.; dimensions of box, 72 x 56 x 30 in.

The cutter and work spindles are driven by separate belts from the same countershaft. The headstock can be swiveled on the bed so that taper threads can be milled. The carriage is moved an amount equal to the lead of the thread at each revolution of the work by a lead cam and the cutter is fed to depth and withdrawn by a depth cam. Varying feeds and speeds are taken care of by the countershaft pulleys and by the change gearing provided. Both internal and external threads can be milled. By substituting a milling cutter for the threading hob, circular milling on small work can be done; and, by changing the shape of the feed cam, irregular shapes can be milled.

The machine is mounted on a substantial base of which the oil pan is an integral part. One-half the base is used as an oil reservoir and the other half for a tool cabinet. An oil pump is included in the regular equipment.

The lecture program of the Franklin Institute for the current season is notable both for the well-known men who speak, and the subjects covered. On Feb. 26 the artillery of the A. E. F. was illustrated and described by Major-General C. C. Williams, Chief of Ordnance, U. S. War Department. Further lectures are: March 4, The Manufacture of Plate Glass, by G. A. Rankin; Mar. 11, Photographing Sound Waves from Large Guns and Projectiles, by Dayton C. Miller; March 17, The Induction Electrical Furnace, by G. H. Clamer; March 25, Optical Glass and Its Future as an American Industry, by Dr. Arthur L. Day; April 1, Aëronautical Instruments, by Dr. Chas. E. Mendenhall. Other lectures by prominent men will be made on April 8, 15 and 21.

What Other Editors Think

The Itch for Change

FROM *Wall Street Journal*

IF Germany had won the war it is conceivable that she might have imposed upon the world a great many things the world does not really want. These drill-sergeant changes accord well with the habit of the German mind. But they do not at all suit what is inaccurately but conveniently called the Anglo-Saxon mind. This is why the agitation for a metric system, compulsory all over the world, has actually lost ground in the past few years in spite of some financed propaganda apparently originating in San Francisco.

* * *

Any system of weights and measures is necessarily only a means to an end. It is like a country's constitution, or a dozen other things. If the end of good government is attained, theoretical imperfections in the constitution may be wisely left alone. The British constitution, in fact, is the most efficient in the world, and it defies you to put your thumb on it. It achieves excellent government, which is the end for which it exists. The English system of weights and measures achieves a highly efficient international commerce, and there is no real evidence that that commerce would be improved by the scrapping of the yardstick and the pint measure.

It is not really true to say that the British weights and measures were of German origin. In the form in which the Normans found them these measures had Saxon names, but let us remember that the Saxons from which the English sprung were first cousins of the Norsemen and not even distantly related to the Hun or his parvenu descendant, the modern Prussian. Of all the diverse elements which went to the making of the homogeneous English race perhaps the most inconsiderable was the German or his real ancestors.

Loosely, in a way not to lay down a deceptive generalization the English system of weights and measures is related at many points to the system of measuring time, which is the basis of the navigation of all nations. The days, hours and minutes are solar, and the advocates of the metric system at the outset broke their shins over something so intangible as the meridian of Greenwich.

* * *

The metric system has its scientific uses and it may be left to such uses. Not only is it discarded in Spain, one of the Latin countries, for something less "scientific" but closely related to our own. You cannot even get the Frenchman to talk of five centimes. He speaks of a "sou," and what is more he speaks in multiples of sous, to the embarrassment of the American tourist.

This country is engaged at present in the eminently proper task of persuading people to let our excellent Constitution alone. There is all kind of work to do in our imperfect world. There is no present or probable future need for legislative meddling with the system of weights and measures which an overwhelming part of the trading world already accepts and understands. Any legislative enactment in Congress or in the British Empire Parliaments which was more than merely permissive would do an incalculable amount of harm, at the price of a merely theoretic uniformity which the business of the world neither needs nor wants.

The Combined Pocket-book Is Not So Fat as You Think

FROM *American Magazine*

EVERYBODY wants a higher income. Fine! A laudable ambition! But don't get the idea you can pick it off the trees.

Just now the human race is on one of its periodical "bats," during which it has the foolish idea that it can get something for nothing. The notion is abroad in the world that you can arbitrarily ask for almost any kind of an increase in income—and get it.

But this is just where the error lies. There isn't as much wealth and combined income in the world as we imagine. And if we don't all get busy and go to work pretty soon there will be a whole lot less to fight over than there is now.

I know a corporation having 2,000 employees, where the average pay of all employed is about $1,300 a year—or $25 a week. Nobody in the entire establishment gets less than $12 a week. Most of the employees get from $20 to $25. A few of the managing officials get good-sized salaries. The general manager gets $20,000 a year. Perhaps ten others get an average of $10,000. The profits of the business are about $600,000 a year. Now suppose that $600,000 should be taken away from the stockholders entirely and divided among the employees. It would give an increase in pay of only $6 a week. Surely not a large sum.

Now suppose, in addition, you took the general manager and his $10,000 associates and threw them out. And suppose you took their combined salaries ($120,000 a year) and divided the money up with the workers. That would give each an increase of $1 a week! Of course, the fact of the matter is that without some return to the stockholders and some higher salaries for skilled managers you wouldn't have any business at all. The whole thing would blow up and all of the 2,000 employees would be on the street.

Think this over carefully. Study the concern you are connected with. Figure out where your best chance lies. Suppose you were with the company I have just referred to. Would you want to fire all the officers and stockholders and have $7 a week more until the sheriff arrived? Or would you rather run the thing as it is and perhaps get an increase of $10 or $15 or $25 a week if you show yourself abler and more industrious than some of your fellow workers?

Sparks from the World's

By E. C. Porter,

Duty-Free Admission of Samples for Bordeaux Fair

Consul Theodore Jaeckel, Bordeaux, France, states that samples for the Bordeaux Fair will be admitted by the French customs authorities under bond, free of duty, or upon payment of the duty which will be refunded upon re-exportation of the samples. The Compagnie General Transatlantic will return the samples to the United States without charge. Embargoes against the exportation of goods will not apply to samples.

The annual commercial and industrial fair will be held at Bordeaux, France, from June 5 to June 20, inclusive. All particulars regarding shipments and space may be obtained from A. D. Straus & Co., 18 Broadway, New York City, the official representatives of the fair committee. It is suggested that interested American firms act at once; from previous experience with the exhibits for the Bordeaux and Lyons fairs, considerable delay was encountered in many cases, which prevented exhibits from arriving in time to be displayed.

Machinery Will Do World's Work Says Edison

Despite submarines and subways, wireless telephones and telegraphs, the conquest of the air, and developments in industrial chemistry, Thomas A. Edison during the celebration of his seventy-third birthday, "asserted the world is only beginning to develop."

"We have efficiency today but only in a primitive stage," the scientist said. "Our efficiency will continue to increase for the next 1,000 years."

Edison predicted the new world will be run entirely by machinery. The worker, he said, should be but the brains behind a machine. Brain power, in the form of highly developed mechanical apparatus, must supplant man power in all forms of industry, he added.

As an illustration the scientist pointed out that in the future development of machinery it would be possible to put wool into a machine and have it delivered as cloth, where now separate operations for spinning and weaving are required.

Asked about a statement of Guglielmo Marconi, quoted in cable advices from London, as asserting that certain strange wireless signals might be an attempt of inhabitants of the planet Mars to communicate with the earth, Edison declared such a development was "entirely possible."

"The world today is much more efficient than it was fifty years ago," the scientist declared, "but we do not notice it. The development has come on slowly all about us until we have become so accustomed to the new that it has become commonplace."

New Supply Division Manager for Westinghouse Seattle Office

J. G. Miles has been appointed to the position of supply division manager of the Westinghouse Electric and Manufacturing Company's Seattle office. Mr. Miles goes to his new appointment

J. G. MILES

to succeed C. V. Aspinwall, now the company's representative at Spokane, Wash.

Mr. Miles has seen long service in the supply department of the Westinghouse company, serving for several years as the head of the insulation section, at East Pittsburgh, Pa.

Latin-American Trade

The grand total of international trade of the twenty Latin-American Republics advanced from about $3,000,000,000 in 1913 to nearly or quite $5,000,000,000 in 1919. The exports show an increase of nearly 100 per cent in stated value, and the imports, an increase of about 50 per cent; though it is proper to add that these increases in the grand total of values are due in a very considerable degree to the higher prices in 1919.

Armour Institute of Technology Receives Big Gift

The announcement has been made that J. Ogden Armour has made a gift of $6,000,000 to the Armour Institute of Technology, which was founded by his father, P. D. Armour, in 1892. It has been felt for some time that the institution had outgrown its present quarters at Thirty-first and Federal Sts., Chicago. On looking around for a new site its president, Dr. Frank W. Gunsaulus, selected a plot of eighty acres located at Seventy-fifth St. and Yates Ave.

When this proposition was put up to Mr. Armour he agreed to give $1,000,000 for the purchase of this site and a further sum of $5,000,000 for the erection of the new buildings. The new location is near the steel-mill district of South Chicago, which will afford excellent opportunities for visits by the students to this great industrial center. It is also within a very short distance of the lake and it is planned to add a course in marine engineering to the curriculum. The new institution will be planned for a capacity of 1,000 students.

At the time the institute was founded by P. D. Armour its aim was outlined in the following statement: "The institution is founded for the purpose of giving to young men an opportunity to obtain a liberal education. It is hoped that its benefits may reach all classes. It is not intended for the poor or the rich sections of society, but for any and all who are earnestly seeking technical education." The new plans will undoubtedly enable the institute to take a leading rank among the great technical colleges of the country.

National Metal Trades Association's Convention

The National Metal Trades Association, which has its executive offices in the People's Gas Building, Chicago, Ill., will hold a convention in New York City at the Hotel Astor on April 10 to 22. On Monday, April 19, the executive committee meeting will be held at 10 a.m. The secretaries' dinner will be given at 7 p.m. On Tuesday, April 20, 1920: Council meeting, at 10 a.m. to 5 p.m.; meeting of the local branch secretaries, at 10 a.m.; alumni dinner, at 6:45 p.m. On Wednesday, April 21: Convention, at 9:30 a.m. and 2 p.m.; buffet lunch, at 12:30 p.m.; banquet, at 7 p.m. On Thursday, April 22: Convention, at 9:30 a.m. to 2 p.m., and a meeting of incoming administration council.

Industrial Forge

News Editor

New Type of British Airplane Engine

Tests have been completed in Manchester, England, by Captain William P. Durtnall of a new type of airplane engine which will be silent, and from which the danger of fire in the air has been removed. The tests were made on a converted engine that had been previously operated on the Otto cycle system.

At present the exhaust pressure of the gases is very high in ordinary airplane engines, producing considerable noise. Under the system used in the Bowles and Durtnall engine, the exhaust gases leave the engine at ½-lb. pressure per square inch, which results in "silent" operation. With so great a reduction of the temperature, it is claimed to be impossible to get a flame from the exhaust in any circumstances. The further claim is made that cheap heavy crude oil can be used in these engines, and that full power can be produced at altitudes up to 20,000 feet.

Hawthorne, Leslie & Co., of Newcastle, are reported to have secured the rights of these engine improvements for use on the large power internal combustion railway locomotives which they are now building.

The Greenfield Tap and Die Corporation's New Officers and Directors

At the annual meeting of the stockholders of the Greenfield Tap and Die Corporation, of Greenfield, Mass., on Feb. 3, 1920, the following officers and directors were elected:

Officers—Frederick H. Payne, president; Francis G. Echols, vice president and general manager; Leon M. Lamb, secretary and comptroller; Frank A. Yeaw, treasurer; Frederick K. E. Hawks, assistant treasurer.

Directors — Frederick H. Payne, Francis G. Echols, Franklin Judge, Joseph W. Stevens, William M. Pratt, Charles N. Stoddard and Charles Allen.

Dr. Walker Heads "Technology Plan"

The new division of industrial service at "Technology" has just been placed under the direction of Dr. William H. Walker, for over twelve years head of the Research Laboratory of Applied Chemistry, and for over twenty-five years on the staff of the Institute. The success of the undertaking has already been assured by the fact that over one hundred and fifty of the country's largest industrial plants have wholeheartedly indorsed the plan and subscribed over a million dollars.

The selection of Dr. Walker is a logical choice. He received the Distinguished Service Medal, with a citation for his technical ability, industry and zeal, as a reward for the splendid work he did at the Edgewood Arsenal, Maryland, as commanding officer. He overcame labor disputes, directed over fifteen thousand men, obtained materials and completed and put in operation the largest toxic plant in existence, its output being nearly twice that of the other Allies combined.

This innovation for technical schools consists of a contract signed by the manufacturing plant and the Institute. A certain sum annually is specified upon for a certain number of years and for this the Institute agrees to give advice on new inventions, solve problems that need research and special apparatus and permit the use of its libraries of scientific knowledge.

The proposition is to bridge the gap between industrial establishments and the scientific school by making it possible for manufacturers to consult the Institute and its staff on any of the difficulties arising in their business. It is also expected to remove the possibility of losing members of the faculty by their acceptance of tempting offers to give up teaching and work in the various private laboratories scattered over the country. The scarcity of highly specialized technical men cannot be effectively eliminated if the supply is cut off at its source, and the industries of the country now have an excellent opportunity to return some of the service Technology has given them in the past.

Among the concerns which have signed contracts under the Technology plan are the American International Corporation, the General Electric Company, the United States Steel Corporation, and the American Telephone and Telegraph Company.

Delivers Lecture on Lathes for Turning Car Wheels

D. H. Teas, Chicago representative of the Niles-Bement-Pond Co., delivered an illustrated lecture recently before members of the Cincinnati Railway Club at the Hotel Sinton on "Lathes for Turning Car Wheels." In the course of his talk Mr. Teas demonstrated the various steps taken in the manufacture of wheels for locomotives, freight cars and passenger coaches. Colonel Brent Arnold, of the L. & N. Railroad, presided.

A Wireless Device That Will Ring Alarms on Other Ships

A novel wireless emergency calling device by which ships in distress can ring alarm bells on other ships within wireless range is reported by the American Chamber of Commerce in London.

The present wireless system of communication requires that an operator to hear a call must be on duty, wearing the usual telephone headpiece. The new device is said to enable any station or ship equipped with a special automatic transmitter key to call up any station or ship within range, fitted with a corresponding selective receiver relay, even if the operator is absent. The calling up is effected by a bell.

It is claimed that one of the most important uses of the devices will be to insure immediate and general attention to S. O. S. calls.

Chamber of Commerce of United States to Have Foreign Trade Department

Chauncey D. Snow has resigned as United States commercial attaché at Paris to head a newly created foreign department of the Chamber of Commerce of the United States. Mr. Snow, who went to Paris a little more than a year ago to investigate markets in France for American goods, formerly was first assistant chief of the Bureau of Foreign and Domestic Commerce.

Creation of the foreign-trade department by the United States Chamber of Commerce is the first step toward a reorganization of the chamber's machinery designed to divide the work of the chamber up along the lines of the great divisions of industry. Other departments to be instituted soon include domestic production and distribution, transportation, insurance, finance and civic development.

Americans at Lyons Fair

Seventy-five American firms are inscribed as exhibitors at the Lyons samples fair to be held March 1 to 15. The French firms number 2,100; British, 126; Italian, 105; Swiss, 68; Belgian, 15; Spanish, 21; Dutch, 12; Roumanian, 11; Czecho-Slovakia, 25. Among the American exhibitors are twenty-five shoe manufacturers and fifteen tanners and allied trades.

Coal Production

Production of soft coal for the week ended Feb. 14 amounted to 10,284,000 tons. Anthracite production amounted to 1,773,000 tons.

Trade Currents From New York, Cleveland and Chicago

NEW YORK LETTER

Machine-tool developments during the past week have showed improvement in most lines, with a demand for inspection tools being strongly in evidence. Toolroom equipment looms prominently among other inquiries.

Orders appear to be increasing in size, as several $50,000 sales during the past week indicate. The greater number of sales though are between $5,000 and $10,000, but a gradual trend upward is expected from now on.

The railroad freight situation is giving dealers some concern. One dealer has thirty carloads of machine tools held up between New York and a New England point indefinitely. Another reports a large shipment held in a nearby classification yard with but little chance of being released for some time.

Less than carload lots are being refused by railroads in many places, and some dealers find this situation an effective bar to reasonable deliveries. Thirty thousand cars are waiting at Chicago to be shipped East, and there are hundreds of thousands of dollars worth of machine tools represented that are consigned to New York dealers. A number of freight embargoes also contribute to the uncertain machine-tool delivery situation.

Textile machinery is active, and numerous inquiries presage a large volume of business in this line.

Silk mills are in the market in increasing numbers for machine-shop equipment. They are showing a tendency to do their own shopwork rather than "farm" it out. A number of sales to silk mills—particularly in the Paterson, N. J., district—are reported, and the equipment called for is the best and most expensive obtainable in most cases.

Due to a number of the larger dealers changing lines recently, "floor samples" of the discontinued lines are being offered at rates considerably below prevailing price schedules for similar equipment. The Fairbanks Co. recently made a number of changes, and is now handling several popular lines of machine tools heretofore unrepresented in New York.

CLEVELAND LETTER

Numerous inquiries with few proportional sales and negligible cancellations, sum up Cleveland machine-tool activities for the past week.

Most of the business on the books of local dealers is for delivery to the automotive trade. It is stated that this industry generally has orders booked for a year ahead, and has contracted for machine tools to be delivered over that period.

Railroad buying in this territory is booking up slightly. A few inquiries have been received, but actual orders are very light.

Local machine-tool interests are making preparations to solicit South American and Oriental trade, now that European exports are off, and considerable business is being booked for delivery to oil interests in the Tuxpan-Tampico region of Mexico.

CHICAGO LETTER

Renewed activity is reported by all dealers, two concerns reporting such an influx of business during the past week as to insure a February total in excess of January's. Many deals which have been under way for some time are being closed. Local sales remain light. It is the wide stretch of manufacturing territory contiguous to Chicago which is doing the buying.

Washing-machine manufacturers hold the center of the stage at present as buyers. One firm last week placed orders for tools aggregating over $20,000, to be billed at the prices prevailing at time of delivery. Quantities of punching and drilling machines are wanted by this class of user, and sheet-metal-working machinery is largely in demand. Heavy-duty tools continue active, one manufacturer reporting his entire production for the year 1920 already sold, except for a few boring mills.

Tendency on the part of electric-motor repair shops and automobile repair men to place large and expensive machinery is growing. One electric motor repair man last week bought three machines totaling over $5,000, this incident being merely typical. Inability of auto makers to turn out new cars as fast as wanted has made the auto rebuilder very busy, making him a good customer of the machine-tool dealer.

Shortage of raw materials is becoming more of a problem to all manufacturers. Black steel sheets are at present particularly hard to get, and in some urgent cases it is said brass is being substituted. Some plants are threatened with a shutdown on this account.

Local building conditions remain unsatisfactory. Aside from three or four $25,000 garages, no new construction of interest to the machinery trade was announced during the week. Johnson Fare Box Co. has let the contract for the construction of its new $125,000 plant. They are going to move their old machine equipment and will not be in the market for much new stuff.

Established in New Plant

The Tabor Manufacturing Co., manufacturer of molding machines, cutters, etc., is now established in its new plant at Wissinoming, Philadelphia. This company's plant was burned at North 18th and Hamilton Sts., and the company was unable to locate on its site purchased at Nicetown, as it was taken over by the Government. The new location consists of 5 acres and a building, 100 x 350 ft., of steel and concrete construction. An addition 100 x 100 ft. has been made to the present building.

Exports and Imports Show Large Increase for January

Despite the foreign exchange situation, the trade balance in favor of the United States increased $257,000,000 in January, according to figures made public recently by the Department of Commerce. Both exports and imports showed an advance, the value of goods sent out of the country being $731,000,000, and that of those received, $474,000,000.

The exports compared with $682,000,000 in December and $623,000,000 in January a year ago. Imports compared with $381,000,000 in December and $213,000,000 in January, 1919.

For the seven months of the fiscal year beginning last July 1 exports totaled $4,594,000,000 and imports $2,768,000,000, leaving a trade balance of $1,826,000,000. The trade balance for the corresponding seven months the year before was $2,099,000,000.

Gold imports for the seven-month period amounted to $38,000,000 as compared with $14,000,000 in 1919, and exports $319,000,000, against $23,000,000 last year.

Exports of silver for the same period amounted to $122,000,000, compared with $179,000,000 in the corresponding period the year before.

Gold exports for the month of January amounted to $47,758,038 and imports to $12,017,551. Silver exports for the month totaled $24,627,678 and imports $8,863,251.

Steel Shortage in Great Britain

"British users of steel billets are in hard straits for adequate supplies," says Trade Commissioner Wilbur J. Page. "A large South Wales firm appealed to for supplies reported that freight cars sufficient to supply only half the required quantity of pig-iron coal could be obtained, and that it had to cut down its production of steel billets accordingly.

"The shortage is assuming alarming proportions. One of the largest structural engineers in the Midlands is held up on nine-tenths of his contracts for lack of steel. In the northeast a large steel works reports that it has 20,000 tons awaiting delivery, but cannot secure freight cars. The stoppage of American supplies of steel has caused great difficulties to firms which for several months past have been depending almost entirely on foreign steel. This shortage has been particularly felt in the lines of flat strip for tube making.

"Galvanized sheets are most difficult to get. Sample lots of galvanized sheets are bringing as high as £39 ($189.79) per ton. Many of the large producers state that their full production has been booked well into the spring. Carbon crucible steel producers in the Sheffield district report strong developments in the export demand. South American and South African markets are buying freely, while France and Italy are also placing considerable orders."

Advertising the Foreman Who "Spilled the Beans"

From two widely separated sections of the country, from two distinct types of industries, come accounts of good results accomplished by advertising the names of foremen in whose departments accidents occur as well as those whose departments show clear records.

The Halcomb Steel Co. of Syracuse, N. Y., publishes prominently in its plant organ, under the heading of "Who's Who in Safety," each month, the names of all foremen in whose departments there were no accidents during the previous month. Directly opposite, under the heading "Those Who Spilled the Beans," are published the names of the other foremen, with the number of accidents charged to his department after each name. The Corn Products Refining Co., Chicago, last October conducted a safety drive among all its plants, at the close of which a bulletin was posted showing the name of every foreman in whose department one or more accidents had occurred, together with the number of accidents in each department.

Discussing the effect of such publicity, Grover Kingsley, safety engineer of the Halcomb Steel Co., writes: "This has proved a stimulus to good safety work in a great number of instances. Foremen want to keep their names out of the 'Who Spilled the Beans' column. Contrary to expectations, this sort of publicity does not create antagonism to safety, and I attribute this principally to the humorous phrase used to designate foremen whose departments show accidents."

C. J. Alger of the Industrial Relations Department, Corn Products Refining Co., writes: "Opinions from the various plants differ. Of course, the victorious plants are very much satisfied with the plan. On the other hand some plants reported that this posting of names makes some foremen feel that the good work that they accomplished during the drive was not appreciated. My personal opinion is that if the foremen are warned as to the manner in which their names are to be published in the event of accidents in their department during the drive, it certainly would have a tendency to cause them to exert their utmost efforts. We feel that the results obtained more than offset any possible criticism on the part of a few foremen."—*National Safety News.*

Page Steel and Wire Acquired by American Chain

The American Chain Co., Inc., of Bridgeport, Conn., has purchased the control of the Page Steel and Wire Co., with mills at Monessen, Pa., and Adrian, Michigan.

It is the intention of the American Chain Co. to continue the business of the Page Steel and Wire Co. as heretofore, taking only its surplus product. The latter company's plants consist of openhearth furnaces, rolling mill, wire mills, as well as fence factories.

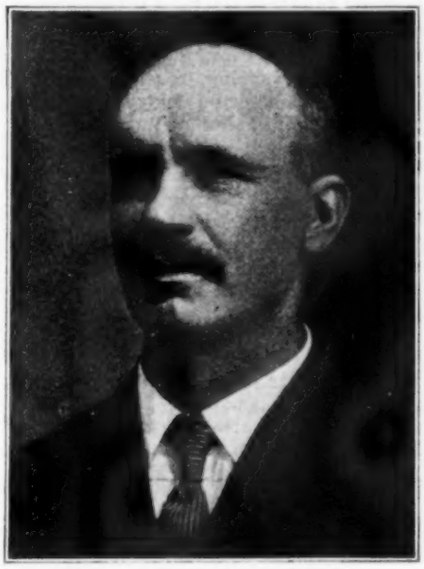
The new officers elected under the reorganization of the company are: Walter B. Lashar, president; William T. Morris, vice president; Wilmot F. Wheeler, treasurer; John E. Carr, assistant treasurer, and William M. Wheeler, secretary.

E. C. Sattley, general manager of the Page company, will continue in that capacity with offices in Pittsburgh, Pa.

The American Chain Co. has its general sales offices in the Grand Central Terminal Building, New York City, and district sales offices in Chicago, Boston, Philadelphia, San Francisco, Portland and Pittsburgh.

John Hettich

John Hettich of the R. K. Le Blond Machine Tool Co., Cincinnati, Ohio, superintendent of milling-machine construction, died Jan. 27, 1920. He entered the employment of this company, July 27, 1903, to take up the duties of foreman of one of the departments. He held this position until July 19, 1918, when he was promoted to the position he was holding at the time of his death.



JOHN HETTICH

The Platt Iron Works Has Been Sold

The Dayton Malleable Iron Co., Dayton, Ohio, has purchased the plant of the Platt Iron Works Co., located in North Dayton. The purchase includes 10 acres of ground on Herman Ave. Immediately after the completion of the deal the announcement was made that the Gartland-Haswell-Rentschler Foundry Co. was formed to lease the plant and operate it. Gordon S. Rentschler, of Hamilton, is president; M. F. Gartland, of Marion, Ind., vice president, and John C. Haswell, of Dayton, secretary-treasurer. Peter V. Gartland will be general manager. The Dayton Malleable Iron Co. will retain the other property for its own use.

Advertising Engineers Opens Offices in New York City

The Advertising Engineers, Inc., 50 Union Square, New York City, has opened an office for the purpose of carrying on a business as conselors for advertisers of engineering and technical products.

Curtis F. Columbia will act as Eastern manager. He was formerly publicity engineer for the New Jersey Zinc Co. and the United States Gypsum Co., and has for a great number of years been connected with the metallic industries. He is a member of the American Society of Civil Engineers, American Society of Testing Materials and Princeton Engineering Association.

Associated with Mr. Columbia are Virgil G. Marani, M.E., former building commissioner of Cleveland; Victor Hugo Halperin, Ph.B., formerly advertising manager of the General Fireproofing Co.; F. W. Leggett, E.E., director of publicity of the Bell Telephone Co.

Personals

J. HOBART BRONSON, president and treasurer of the Oakville Co., Waterbury, Conn., has resigned as president of the Citizens' National Bank of Waterbury.

RALPH G. FARRELL, official of the Bridgeport Screw Co., Bridgeport, Conn., has been appointed a director of the Connecticut National Bank of Bridgeport, Conn.

JOHN K. WILLIAMSON, head of the Porcupine Co., Bridgeport, Conn., maker of the "Porcupine" boilers, has been made a director of the Connecticut National Bank of Bridgeport, Conn.

P. J. CONNOR, formerly special representative for the International Machine Tool Co., Indianapolis, Ind., is now associated with the E. L. Essley Machinery Co., Chicago, Ill., as its sales representative.

F. J. HOUGH has been appointed superintendent of the Collins Co., Southington, Conn., manufacturer of edge tools, etc. This vacancy was made by the death of C. H. Smith. Clair M. Elston has been made assistant superintendent to succeed Mr. Hough.

FRANK O. WELLS, after forty-seven years' association with the Greenfield Tap and Die Corporation and parent organizations, has resigned his office and sold his holdings in the corporation. Mr. Wells will, however, remain with the corporation in an advisory capacity.

J. L. LAURENCE, formerly representative of the Director of Air Service in the machine-tool section for the Director of Sales Office of the War Department, has resigned from that position to join the sales division of J. T. Ryerson & Sons. Mr. Laurence will be in the New York office and will have charge of the sales in Massachusetts, Connecticut and New York.

Business Items

Charles Austin Hirschberg, Inc., advertising counselors, has announced that it is now located in its permanent quarters at 426 Sun Building, 150 Nassau St., New York City.

The Simplex Tool Co., Woonsocket, R. I., manufacturer of toolroom specialties and the direct-reading micrometer, has announced that it will increase its floor space and equipment.

W. M. Cowan and W. B. Alford have organized the Cowan-Alford Machine Corporation at Macon, Ga., to manufacture a machine for boring. Mr. Cowan and Mr. Alford are the joint inventors of this machine.

The Danbury Foundry Co., Inc., Danbury, Conn., has been incorporated with a capital of $25,000 to manufacture castings, etc. The incorporators of the new company are R. J. Hausin, E. Hausin and W. H. Cable, attorney.

W. D. Reeves and Paul D. O'Kelley have organized the Reeves-O'Kelley Machine Co., and have opened a shop at 45 Auburn Ave., Atlanta, Ga. They will make a specialty of gear cutting and repairs of automobile parts and machinery.

The Electrolabs Co. has consolidated all its offices at 2635 Penn Ave., Pittsburgh, Pa., and in the future all correspondence should be addressed to the Pittsburgh office. A branch office will be maintained at 30 Church St., New York City, room 313.

The Hartford Tool Works, Inc., Hartford, Conn., has been organized to deal in machinery, tools, etc., and will commence operations immediately. The capital of the new company is $75,000. The organizers are A. A. Engstrom and A. M. Engstrom, both of Newington, Conn., and E. G. Nelson, Hartford, Conn.

The Cincinnati Automatic Machine Co., Cincinnati, Ohio, has purchased from the Windsor Machine Co., Windsor, Vt., the manufacturing, selling and patent rights of the Gridley automatic multiple drilling machine. This company proposes to manufacture this machine along with its multiple-spindle automatic machine.

The J. N. LaPointe Co., manufacturer of broaching machines, New London, Conn., has opened a branch office at 11 Harper Ave., Detroit, Mich., in connection with which a stockroom and repair shop is maintained as well as a warehouse in which is carried a stock of the company's broaching machines. This Detroit branch is in charge of Wm. L. Nicholls.

The Bridgeport Castings Co., manufacturer of castings, etc., which recently purchased the old plant of the Bridgeport Tube Works, North Ave., Bridgeport, Conn., had its plant completely destroyed by fire. The company is now engaged in rebuilding the plant and expects to be in operation soon.

The Bridgeport Castings Co. was recently organized and incorporated with H. B. Houghton, president; E. P. Quinn, secretary and treasurer.

The Erie Crucible Steel Co., of Erie, Pa., makes the announcement of the appointment of the Cleveland Steel Supply Co., Cleveland, Ohio, as its agent for the Cleveland district. C. E. Schnibbe is manager of the latter company and was formerly with the Halcomb Steel Co. for twelve years, five of which he was connected with the company's Cleveland branch as salesman. In March of last year he severed his connection with the Halcomb Steel Co. and organized the Cleveland Steel Supply Co.

The Golden Co., exporter and importer, 405 Lexington Ave., New York City, announces that it is the sole and exclusive American agent for Société Genevoise d'Instruments de Physique, makers of comparators for the gaging of steel balls, ball bearings and machined parts of every description; also universal measuring machines, reference gages, scientific instruments and dividing engines for cylindrical, conical, circular and linear work.

The Connecticut Tubing Co., 556 Capital Ave., Hartford, Conn., has been incorporated to manufacture tubing, etc. The officers of the new company are: Walter B. Lashar, president; Bernard I. Ashman, vice president; E. L. King, secretary and treasurer; A. E. Oldroyd, assistant treasurer; J. B. Camplin, assistant secretary. Mr. Lashar is president of the American Chain Co., Bridgeport, Conn., and is also president of the Pratt & Cady Co. Mr. Ashman is a real-estate operator; Messrs. King, Oldroyd and Champlin are connected with the Pratt & Cady Co., Hartford, Conn.

New Incorporations

The Eastern Shear Co., of New Haven, Conn., has been incorporated to make and deal in scissors, shears, cutters, etc. The capital is $100,000, and the organizers are L. M. Molloy, T. F. Calahan and C. E. Moore, all of New Haven.

* * *

The Duval Tool Co., of Central Falls, R. I., was recently incorporated to manufacture and deal in machine tools, etc. The organizers of the company are Ovila Liscault, 73 Fuller Ave., Central Falls, to whom communications should be addressed, and James P. Duval and Ernest Tessier, both of Central Falls.

* * *

The Standard Safety Manufacturing Company, Inc., 265 Park St., New Haven, Conn., has been incorporated with a capital stock of $60,000, to make and deal in safety devices for machinery, etc. The officials of the company are: President, G. M. Eggleston; vice president, Charles Becker; secretary, E. C. Regan; treasurer, C. S. Oswold. The concern, it is reported, will commence operations soon.

Obituary

HAROLD MCGILL DAVIS, publicity manager for the Sprague Electric Works of the General Electric Co., died on Monday, Feb. 16, 1920, at his home at Seventy-Third St., Brooklyn, aged fifty-nine years.

JAMES GAYLEY, internationally prominent as a metallurgist, and a former vice president of the United States Steel Corporation, died at his home in New York, Feb. 25, 1920, after an illness of several weeks. Mr. Gayley at one time was president of the American Institute of Mining Engineers.

WALTER P. PHILLIPS, former president of the Columbia Graphophone Manufacturing Co., Bridgeport, Conn., died at his home in Vineyard Haven, Mass., on Jan. 31, 1920. Mr. Phillips was born in Grafton, Mass., in 1846. He was the inventor of the Phillips code for telegraph operators, and was at one time engaged in the telegraph business in New York and Providence.

Short News Notes

The American Implement Co., Elyria, Ohio, is planning the construction of a new plant for the manufacture of small tractors.

* * *

The Doelger & Kirsten Co., Milwaukee, manufacturer of metal-working machinery, will build a two-story machine shop addition, 90 x 200 feet.

* * *

The Motor Castings Co., Milwaukee, organized last summer, is placing its new gray-iron shop at Fifty-sixth St. and Greenfield Ave., West Allis, in operation. The plant will specialize in castings for the automotive industry.

* * *

Marion Machine Foundry and Supply Co., Marion, Ind., has recently completed four units of a factory. They are the assembly building, warehouse, foundry and an office building.

* * *

The Case Manufacturing Co., Jackson, Mich., is making plans for a new factory.

* * *

The American Enameling and Stamping Co., Bellaire, Ohio, is preparing to make extensive additions to its plant.

* * *

The Lewis Manufacturing Co., Massilon, Ohio, makes the announcement that it has commenced the production of switches and switch boxes.

* * *

The Steinwender-Stoffrege Coffee Co., St. Louis, Mo., is planning to install its own can-making plant.

* * *

The Winslow Bros. plant, located on the Belt Line Railroad, which was one of America's heaviest shell producers during the war, has been sold to M. C.

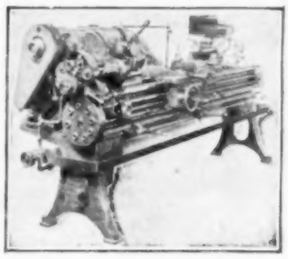
(*Continued on page* 538*b*)

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

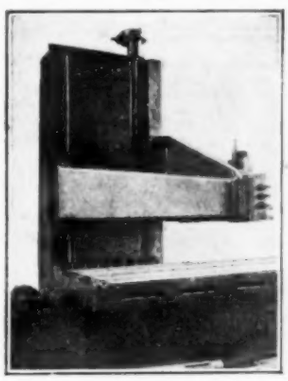
Lathe, "Ideal" Geared-Head Engine.
Springfield Machine Tool Co., Springfield, Ohio.
"American Machinist," Feb. 19, 1920.

Size, 14 in. x 8 ft. It is motor driven, has rapid change gears, relieving attachment, taper attachment, oil pan and pump. Geared head is of selective type having twelve mechanical changes of speed; is provided with ball bearings throughout, with exception of spindle journals, which are adjustable. Back gears may be used for the cut and without disengaging half nuts; tool may be returned at a speed ten times as fast as cutting speed. Relieving attachment will cut from two to twenty-six flutes per revolution of spindle; will relieve right- or left-hand threads both external and internal.



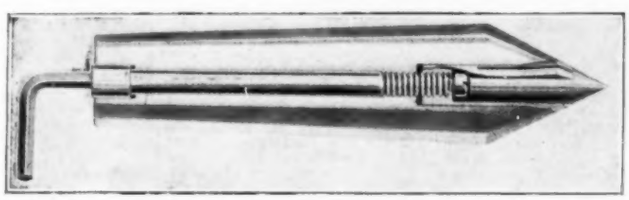
Planing Machine, Open-Side.
F. R. Patch Manufacturing Co., Rutland, Vt.
"American Machinist," Feb. 19, 1920

Specifications: Planes, width, 48 in.; height, 48 in.; table length over all, 15 ft. 6 in.; width, 44 in.; length of bed, 23 ft. 4 in.; down feed, 9 in.; floor space length, including table travel, 32 ft.; maximum height under rail, 50 in.; horsepower required, 15 to 25; crossrail motor, 2 hp.; net weight of machine without motor, approximately 40,375 lb.



Centers, Improved Lathe.
Senn Tool and Machine Co., 90 Shelby St., Detroit, Mich.
"American Machinist," Feb. 19, 1920.

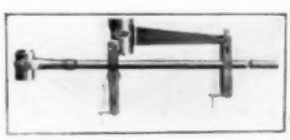
The body of the center is of machinery steel, carbonized. The outside taper and collet hole are both ground to size. Collet is



made from tool steel and is hardened and ground. Screw is of cold-drawn steel and is cyanided. The center point is of high-speed steel and is heat-treated. Small socket wrench is furnished with each center. The center is manufactured in all standard sizes and tapers, and the parts are interchangeable.

Riveting Rig, Liberty, Bottom.
Liberty Tool Co., Munsey Bldg., Baltimore, Md.
"American Machinist," Feb. 19, 1920.

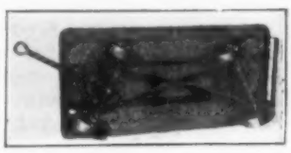
When used for ship riveting is attached to ship's bottom by a single bolt that passes through the center swivel bracket. Riveter held at end of radius arm in cylinder bracket which is supported in a yoke and adaptable to any riveter. The round radius arm is supported at two points upon convex rollers mounted in



crossheads. These may be screwed up or down by crank handles at ends of the brackets. The device ordinarily works on a radius of 10 ft.; is operated by one man. Yoke on the end of the radius arm is tapped for 1¼-in. standard pipe so that it can be equipped with any length of radius arm. Full-length radius arm is furnished with each rig.

Truck, W. & I. Sixth-Wheel Trailer.
Warren & Irrgang Co., Springfield, Mass.
"American Machinist," Feb. 19, 1920.

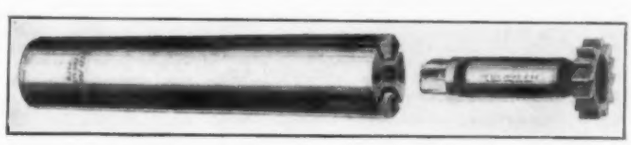
Truck is made in three stock sizes, with capacities of two, three and four tons, respectively. The 30 x 72-in. size has 12 x 3-in. wheels and will turn in a 4-ft. circle. The 40 x 120-in. size requires a 6 ft. circle to make the turn and has 14 x 3-in. wheels.



Centers, "Red E" Lathe.
Ready Tool Co., Bridgeport, Conn.
"American Machinist," Feb. 19, 1920.

The high-speed-steel point of each center is electrically welded to the nickel-steel body and extends back about one-quarter of the length. The advantages claimed for these centers are long life; no tendency to burn or freeze to the work, and that a machine equipped with them can be run faster and more steadily. The center is made in all standard sizes and tapers, suitable for lathes and grinding machines.

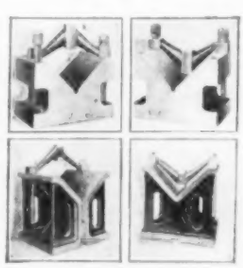
Chucks and Cutters, Woodruff Keyway.
Scully-Jones & Co., Railway Exchange Bldg., Chicago, Ill.
"American Machinist," Feb. 19, 1920.



Designed especially for the milling of keyways for Woodruff keys. The chucks are hardened and ground and can be furnished to fit all standard tapers. The cutters have squared shanks and are furnished in all standard sizes to fit Woodruff keys.

V-Blocks, Taft-Peirce.
Taft-Peirce Manufacturing Co., Woonsocket, R. I.
"American Machinist," Feb. 19, 1920.

Made in two styles, as illustrated; the solid type in the 4-in. size and the skeleton type in the 6- and 8-in. sizes. These three sizes are intended to meet all conditions met in shop practice. The blocks are furnished in pairs. In each case the V is central with the sides. The 4-in. block is made of tool steel, hardened and ground. Sides are undercut to permit the use of clamps for holding the blocks in place. The 6- and 8-in. sizes are provided with a slot in one end and in the base, as well as one bolt hole in the base and one in the end, for clamping the blocks in place.



Clip, paste on 3 x 5-in. cards and file as desired

Short Trade Notes

(*Continued from page* 538)

Rosenfeld of Cleveland, Ohio. Mr. Rosenfeld, who is connected with McCool Co., of Cleveland, makes no announcement as to his intentions for the future. The lathes, which are largely Amalgamated equipment, are being offered for sale.

* * *

Lindstrom, Smith & Co., Cleveland, maker of electric specialties, and the Tuthill Spring Co., manufacturer of auto springs, have both let contracts for new factories, to cost, respectively, $125,000 and $200,000.

* * *

The Plamondon Manufacturing Co., machinery builder, is beginning construction of a quarter-million dollar plant on the southwest side, Cleveland, Ohio.

* * *

Republic Blow Meters Co., Cleveland, has commenced the construction of its new plant.

* * *

The Federal Machinery Sales Co., 12 North Jefferson St., Chicago, has added to its line, as sole agent, the product of the Universal Boring Machine Co., of Hudson, Mass.

* * *

The Columbia Enameling and Stamping Co., Terre Haute, Ind., is planning to increase its present capacity. This company expects to occupy its new building some time this fall.

* * *

W. E. Ackerman, of Wheeling, W. Va., is the head of a new concern being organized to make can machinery. The firm will be a combination of the Ackerman Manufacturing Co. and the Whittaker Glessner Co., of Wheeling.

* * *

The Dunning Heating Supply Co., Milwaukee, expects to move into its new factory in a short time. New equipment throughout is the policy adopted.

* * *

On completion of its naval-gun contract, the Savage Arms Co. will convert its Sharon, Pa., plant into the production of motor-car axles and bearings. It is said that production in the new line will be under way soon.

* * *

The Hayes Wheel Co. (steel wheel division), of Jackson, Mich., will build and equip another unit equal in size to its existing plant.

* * *

The Jackson Motors Corporation has completed buying of a large equipment list, and will be out of the market for most lines for about six months.

* * *

The Williams Test Clamp Co., of Cleveland, has rented additional space for the production of the "Outlook" Wind Shield Cleaner.

* * *

The D. D. Clark Manufacturing Co., of Salem, Ohio, has been acquired by the W. H. Mullins Co. of the same place. The Clark line of conveying apparatus will be continued by the Mullins Co. on a larger scale, and a department for building closed auto bodies will be established. Two new buildings are under construction to house the added features.

* * *

A new plant to be devoted to cream-separator production is to be built shortly at Renfrew, Canada, by the Renfrew Machinery Co. The company has authorized a substantial appropriation for mechanical equipment.

* * *

The Western Electric Co., of Chicago, plans to increase production in several departments 100 per cent.

New Publications

Engineering Machine Tools and Processes. By Arthur G. Robson, A. M. I. Mech. E., L. C. C. Beaufay Technical Institute. 307 pages, 8 x 5¼ in., illustrations, cloth-board covers. Published by Longmans, Green & Co., 4th Ave. and 30th St., New York; also London, Bombay, Calcutta and Madras.

This book has been written for the benefit of students of engineering. In Chapter 1, measuring tools are described as well as the details of periodic and progressive errors of the micrometer screw upon precision work. Under the heading of "Lathe Details and Tool Design," the research work of Dempster Smith is of importance to students. Improvements upon lathe beds, taper-turning arrangements, graduated disks upon slide screws and indicators for registering position for "picking up" the thread in screw cutting are mentioned. A large variety of lathe tooling operations is described in Chapter 3. The treatment of tool steels and tools, with reference to recalescence points, pyrometers, hardening baths, electrical furnaces, hardness tests and high-speed tool steel is dealt with in Chapter 4. There is a comprehensive chapter upon threading tools, threads and hand reamers in Chapter 5. The durability and cutting powers of dies for holders are given much space. Chapters 6 to 10 deal with drilling machines, milling machines, precision grinding machines, shaping, planing and boring, and capstan and turret lathes. The capabilities of high-speed tools and results achieved by these machines are investigated, and many types of milling operations are shown, together with short notes upon special milling jigs. In discussing grinding machines, reference is made to magnetic chucks, grinding allowance charts, grinding wheels and the grinding of hollow spindles. The capacity of turret and capstan lathes is dealt with, and the methods of "laying out" the tools are illustrated. In the chapter upon "Methods and Trigonometry of the Toolroom," there is a correlation of calculations and workshop processes, with the use of jigs emphasized. In Chapter 12 helpful calculations are introduced while in the last chapter upon "The Properties and Strength of Materials," the results of tests are tabulated and plotted, and the necessary deductions are drawn. Finally there is a collection of formulae and tables.

Trade Catalogs

Automatic Multiple-Spindle Drilling Machine. The Cincinnati Automatic Machine Co., Cincinnati, Ohio. Catalog, pp. 16, 6 x 9 in. This catalog gives illustrations and a description of the Gridley automatic multiple-spindle drilling machine which this company recently purchased from the Windsor Machine Co., of Windsor, Vt.

Hex Semi-Automatic Milling Machine. The F. C. Sanford Manufacturing Co., 2060 Fairfield Ave., Bridgeport, Conn. Circular, 5½ x 8½ in. A two-page circular describing the automatic milling machine for milling spark plugs.

Car Dumpers. The Wellman-Seaver-Morgan Co., Cleveland, Ohio. Bulletin No. 49, pp. 15, 11 x 8½ in. This bulletin gives several illustrations of the W. S. M. car dumper in various plants and it also shows blueprints of these machines.

Demountable Truck Body. American Truck Body Co., Martinsville, Va. Bulletin No. 26, 3¾ x 8¾ in. A general description is given in this bulletin of the Fontaine demountable truck body, also its specifications and price.

Metallurgical Patents. The Chemical Foundation, Inc., 81 Fulton St., New York City. Pamphlet, pp. 70, 6½ x 9½ in. This pamphlet gives the aims and purposes and the reasons for the organization of the Chemical Foundation. It presents reports made to Congress by A. Mitchell Palmer and Francis P. Garvan, Alien Property Custodians. A prospective of this organization is outlined in the last four pages.

Rolling Mills. Standard Machinery Co., Auburn, R. I. Catalog, pp. 65, 6 x 9 in. The illustrations in the catalog show the general design and construction of its machines, and a description is also given. Dimensions are given of each rolling-mill machine.

Price List. J. L. Lucas & Sons, Inc., 3 Fox St., Bridgeport, Conn. This small circular gives the prices of its products such as gear cutting, grinding and milling machines, hammers, lathes, etc.

Computers. Computer Manufacturing Co., 25 California St., San Francisco, Cal. A folder giving the mechanical details, construction and use of the Ross computer; also its price.

Machine Tools. Pedrick Tool and Machine Co., Philadelphia, Pa. Catalog, pp. 96, 7½ x 10½ in. A catalog describing and illustrating the machinery for use in railway shops, shipyards, general machine shops and industrial plants. Specifications are given of each machine.

Forthcoming Meetings

The American Society for Testing Materials will hold its next annual meeting during the week of June 21, 1920, at the New Monterey Hotel, Asbury Park, N. J. This society has its headquarters in the Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. C. L. Warwick is the secretary and treasurer.

The American Welding Society will hold its annual meeting at the Engineering Societies Building, 33 West 39th St., New York City, on Apr. 22, 1920, at 10:30 a.m. Howard C. Forbes is the secretary.

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of each month, alternating with the Employers' Association of Eastern Massachusetts. George D. Berry, secretary, room 50-51, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month. Lewis H. Kenney is the chairman of committee on papers.

Electric Hoist Manufacturers' Association. Monthly meeting at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Pa.

The National Metal Trades Association will hold a convention at the Hotel Astor, New York City, on April 19 to 22, 1920. H. D. Sayre is the secretary.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Pa., Howard Evans, secretary, Pier 45, North Philadelphia, Pa.

Rochester Society of Technical Draftsmen. Monthly meeting last Thursday. O. L. Angevine, Jr., secretary, 547 Arnett Boulevard, Rochester, N. Y.

The Second Annual Aëronautical Exposition of the Manufacturers Aircraft Association, Inc., will be held at the Seventy-first Regiment Armory, 34th St. and Park Ave., New York, on Mar. 6-13, 1920. S. S. Bradley, 401 Fifth Ave., New York City, is the general manager.

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Counterbore, Eclipse, Interchangeable.
Eclipse Interchangeable Counterbore Co., Detroit, Mich.
"American Machinist," Feb. 19, 1920.

Counterbores are furnished with straight or taper shanks. Shanks are left soft. Cutters are made of high-speed steel. Pilot shanks are made of machinery steel, pack-hardened and ground. Lengths of pilots vary from 3 to 6 in., according to the diameter. Diameter of pilot section is ground from 0.004 to 0.010 in. under the size stamped on it. Cutters include all standard sizes from ½ to 5 in. Pilot shanks range in size from ¼ to 2½ in. in diameter. Special sizes are furnished when required.

Angle Irons, Taft-Peirce Slotted.
Taft-Peirce Manufacturing Co., Woonsocket, R. I.
"American Machinist," Feb. 19, 1920

The set is standardized for the following series of sizes:

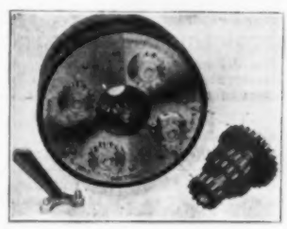
1st Angle Length (In.)	2nd Angle	
4	5	5¼
6	6	8
4	9	5
8	10	12
5	12	6
9	12	10
12	16	14

Slots provided through both faces, and located at right angles to one another. Webs are cast back from the edge and do not interfere with use of clamps. Faces are accurately finished square with each other. In small sizes the angles are ground and in the large sizes they are planed.

Furnace, G. E. Electric Muffle.
General Electric Co.
"American Machinist," Feb. 26, 1920.

Electric furnace designed for temperatures up to 850 deg. C. (1,562 F.) for baking vitreous enamel, hardening and tempering tools, dies, etc. Heating element is mounted on outside of the muffle and covered with compound. Is placed to give even distribution of heat. The element is divided so that it is possible to get two degrees of heat. Pilot lamp acts as a warning to operator when furnace is at high heat. There are connections for rheostats when temperatures as low as 300 deg. C. (572 F.) are desired. Furnace is provided with a shelf in front for convenience; door is equipped with counterweights. High heat requires 4 kw. to bring it up to 850 deg. C.

Chuck, Duplex Universal Gear.
Garrison Machine Works, Dayton, Ohio.
"American Machinist," Feb. 26, 1920.

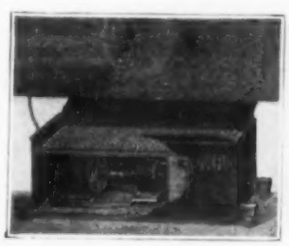


In place of jaws, small eccentric gears are used. Four of these mounted on the outside face of the chuck and free to turn. The face of the chuck is also free to turn in the casing. Three other eccentric gears are mounted inside the chuck on back face. Eccentric gears have but a slight throw when turned. When chucking a cluster the spanner wrench is applied. The gears turn part of a revolution, as they are geared together by the cluster. Chuck has a range of 0.010 in. plus to 0.020 in. minus on the pitch diameter and after hole is ground pitch line will not vary 0.003 in. from truth.

Testing Machine, Autographic Notched-Bar.
Foster Instrument Co., Letchworth, England.
"American Machinist," (English Edition), Jan. 31, 1920.

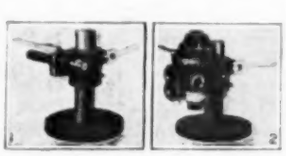
The Humfrey autographic notched-bar testing machine is devised to carry out bending tests on notched bars, to indicate brittleness, etc. The standard test piece is similar to that used for single impact tests in other machines, namely 10 mm. by 10 mm. in section, with a round-bottomed notch V cut at the region to be tested. It is convenient to cut several notches in a long specimen so that consecutive tests may be made, thus giving information as to variation in the bar. The machine is mounted on a heavy metal base; is arranged for operation by unskilled users. It has been found in practice that the correct heat treatment of any material can be determined with ease by testing a series of test pieces, and steel which was previously unreliable has been made to give satisfactory results on the basis of information thus yielded.

Pump, Fulflo Portable Motor-Driven.
Fulflo Pump Co., Blanchester, Ohio.
"American Machinist," Feb. 26, 1920.



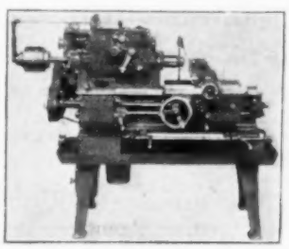
The portable motor-driven pump unit was designed to supply lubricant to the cutting tools on machines not originally equipped with a pump. Can also be used on machines having individual coolant systems when for any reason the system may be out of commission. In operation it is only necessary to roll the unit beneath the machine to be supplied with coolant and to attach the motor cord to a lamp socket. Provision is made for attaching additional splash boards when required. The pump and motor are completely covered and are not affected by dust, grit or chips.

Vise, Thor Pneumatic Drill.
Independent Pneumatic Tool Co., Chicago, Ill.
"American Machinist," Feb. 26, 1920.



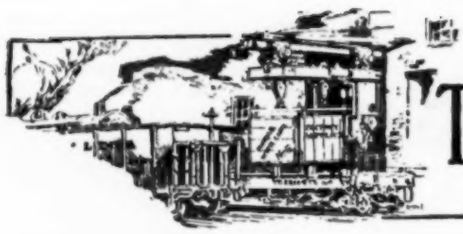
The vise holds the drill body in various convenient positions for assembling, repairing and testing. It is made of a flanged upright column upon which is mounted a stop collar and clamp bracket. The stop collar supports the clamp bracket at the correct height for the workman. The clamp bracket can swivel on the column until securely locked in position by means of the clamp handle.

Lathe, Geared-Head Engine.
Springfield Machine Tool Co., Springfield, Ohio.
"American Machinist," Feb. 26, 1920.



The 14-in. x 12-ft. lathe, known as the "Standard," differs in design to some extent from other geared-head lathes made by this company. A positive clutch is used instead of a friction clutch to return the carriage at high speed when cutting threads. This clutch is operated by the lower lever on the front of the headstock. The machine is equipped with the regular friction clutch by means of which power can be instantly applied or released while the motor is running.

Clip, paste on 3 x 5-in. cards and file as desired



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	Current	One Month Ago
No. 2 Southern	$44.60	$39.10
Northern Basic	42.80	38.20
Southern Ohio No. 2	43.80	40.80
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	47.65	45.65
Southern No. 2 (Silicon 2.25 to 2.75)	47.70	43.20
BIRMINGHAM		
No. 2 Foundry	41.00	35.50
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25 2.75 sil.	45.35–45.65*	42.50*
Virginia No. 2	43.25*	40.00*
Basic	43.00†	40.00†
Grey Forge	42.50*	39.50*
CHICAGO		
No. 2 Foundry local	43.25	40.00
No. 2 Foundry, Southern	46.60	40.50
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	43.65	39.40
Basic	42.90	36.40
Bessemer	43.40	37.40
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$3.97	$3.47	$4.07	$5.50	$3.97	$3.47	$4.07
Soft steel bars	4.12	3.52	3.97	5.00	4.07	3.52	3.97
Soft steel bar shapes	4.12	3.52	3.97	.....	4.07	3.52	3.97
Soft steel bands	4.82	4.22	4.57	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.17	3.67	4.27	5.00	4.47	3.67	4.27

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.00	$3.50
Warehouse, New York	3.52	4.75
Warehouse, Cleveland	3.42	3.90
Warehouse, Chicago	3.52	4.10

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55–4.00	5.57–6.80	5.17	5.35	5.27
No. 12	3.60–4.05	5.62–6.85	5.22	5.40	5.32
No. 14	3.65–4.10	5.67–6.90	5.27	5.45	5.37
No. 16	3.75–4.20	5.77–7.00	5.37	5.55	5.47
Black					
Nos. 18 and 20	4.15–4.80	6.80–7.30	6.02	5.95	6.30
Nos. 22 and 24	4.20–4.85	6.85–7.35	6.07	6.00	6.35
No. 26	4.25–4.90	6.90–7.90	6.12	6.05	6.40
No. 28	4.35–5.00	7.00–8.00	6.22	6.15	6.50
Galvanized					
No. 10	4.70 6.00	7.50–9.00	8.22	5.05	6.65
No. 12	4.80–6.10	7.60–9.10	8.27	5.10	6.70
No. 14	4.80–6.10	7.60–9.10	8.42	5.25	6.85
Nos. 18 and 20	5.10 6.40	7.90–9.40	8.72	5.55	7.15
Nos. 22 and 24	5.25–6.55	8.05–9.55	7.12	6.95	7.55
No. 26	5.40–6.70	8.20–9.70	7.27	7.40	7.70
No. 28	5.70–7.00	8.50–10.00	7.57	7.50	8.00

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$5.50	$5.40	$5.50
Flats, square and hexagons, per 100 lb. base	6.00	5.90	5.50–6.00

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	55
Cleveland	50
Chicago	50

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$21.00–26.00	$25.50–30.00
Cleveland	20.00	20.00
Chicago	16.50	16.50

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
1/4, 11, 5/16, 3/8, 7/16, 1/2, No. 8, 9/16 and No. 10, 5/8, No. 12	21.00 to 30.00	1/4 by 12 in. long	14.00
		1/4 by 19 in. long	12.00
		3/8 by 19 in. long	10.00
		1/2 by 24 in. long	10.00
9/16, No. 14 and 5/8, No. 18, No. 20		Special Welding Wire, Coated	
		1/4	33.00
		5/16	30.00
		3/8	38.00

Domestic 20c. for 1/16, 15c. for 1/8 to 5/16

MISCELLANEOUS STEEL—The following quotations in cents per poundare from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	6.00	8.00	8.00
Spring steel (light)	8.00	10.00	11.00
Coppered bessemer rods	8.00	8.00	6.75
Hoop steel	4.47	6.50	4.32
Cold-rolled strip steel	11.50	8.25	8.00
Floor plates	6.55	6.00	6.27

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
1/8, 1/4 and 3/8	50½%	24%	1/8 to 1¼	30½%	23½%
1/2	54½%	40%			
3/4 to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

1/8, 1/4 and 3/8	46½%	29%	1/2 to 3/4	39½%	24½%
1	51½%	39%			
1¼ to 1½	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	.....	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
½ to 3 in. steel butt welded	40%	24%	40%	31%	54%	40½%
2½ to 6 in. steel lap welded	35%	20%	42%	27%	50%	37½%

Malleable fittings. Class B and C, banded, from New York stock sell at plus 23%. Cast iron, standard sizes, net.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	19.00	19.50	17.50
Tin in 5-ton lots	64.50	63.00	72.50
Lead	9.00	9.00	5.10
Spelter	9.50	9.875	6.50
ST. LOUIS			
Lead	8.37½	8.375	4.80
Spelter	9.225	9.225	6.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago Current	Chicago Year Ago
Copper sheets, base	29.50	29.00	24.50	31@32	30.00	36.00	32.00
Copper wire (carload lots)	29.25	29.25	25.00	29.50	32.00	27.00	28.50
Brass sheets	26.50	26.50	23.75	29.00	32.00	27.00	29.00
Brass pipe	32.00	32.00	34.00	34.00	36.00	35.00	37.00
Solder (half and half) (case lots)	39.00	39.00	38.00	40.50	41.50	38.00	39.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	23.75	20.50
New York	23.75	21.50
Cleveland	29.00	27.00
Chicago	26.00	28.50

SHOP MATERIALS AND SUPPLIES

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 12.00

	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.00	18.75	15.50	18.40
New York	14.00	13.00	14.50	15.50
Chicago	15.00	22.00	15.00	21.50

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	12.00	7.50
Chicago	12.50	8.50
Cleveland	13.00	10.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York		Cleveland		
	Current	One Year Ago	Current	One Year Ago	Chicago
Copper, heavy, and crucible	16.50–17.00	15.00	17.50	15.00	17.50
Copper, heavy, and wire	16.00 16.50	14.00	17.00	14.00	16.50
Copper, light, and bottoms	15.00 15.50	12.00	15.50	12.00	15.50
Lead, heavy	6.75 7.00	4.00	7.50	4.00	8.25
Lead, tea	6.00 6.25	3.00	5.50	3.00	7.00
Brass, heavy	11.50 12.00	8.75	14.00	9.00	17.00
Brass, light	9.00 9.50	7.00	10.50	7.00	11.00
No. 1 yellow brass turnings	9.50 10.00	9.50	11.00	7.00	11.50
Zinc	6.00 6.25	5.00	6.00	3.50	7.00

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	33.00	34.00c.@35.00c.	33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	33.00	27.00
Chicago	29.00	38.00
Cleveland	32.00	29.00–30.00

BABBITT METAL—Warehouse price per pound:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	87.00	73.00	80.00	70.00	75.00
Commercial	50.00	42.00	21.50	18.50	15.00	15.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+$2.00	.80	$1.00	$1.25	$1.25	.98
Hot pressed hexagon	+ 2.00	.80	1.00	1.10	1.25	.78
Cold punched hexagon	+ 2.00	2.50	1.00	1.00	.90	1.00
Cold punched square	+ 2.00	2.50	1.00	1.00	.90	1.00

Semi-finished nuts, $\frac{9}{16}$ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	60%	50–10%
Chicago	50%	50%
Cleveland	60–10%	60%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
$\frac{3}{4}$ by 4 in. and smaller	25%	50%	35–5%
Larger and longer up to $1\frac{1}{4}$ in. by 30 in.	15%	40%	25–5%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York ..... $1.50 Cleveland ..... $4.50 Chicago $3.00

For cast-iron washers the base price per 100 lb. is as follows:
New York ..... $7.00 Cleveland ..... $3.75 Chicago $4.25

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
$\frac{1}{2}$ by 6 in. and smaller	15%	40–5%	30%
Larger and longer up to 1 in. by 30 in.	5%	37½%	20%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	List	30%	List
Chicago	10%	List	10%	List plus 20%
New York	10%	30% from list	10%	10% from list

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel $\frac{7}{16}$ and smaller	30%	45%	45%
Tinned	30%	45%	45%

Boiler, $\frac{3}{8}$, $\frac{7}{16}$, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York...$6.00 Cleveland...$4.00 Chicago....$4.97 Pittsburgh...$4.72

Structural, same sizes:
New York...$6.10 Cleveland...$4.10 Chicago....$5.07 Pittsburgh....$4.82

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	33.50	36.00	35.00
Brass	32.00	34.00	34.00

For immediate stock shipment 3c. is usually added. The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 2c.; for lots of less than 75 lb., but not less than 50 lb. advance is 5c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb. 10c. should be added to base price; quantities from 10-25 lb., extra is 25c.; less than 10 lb., add 35c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as $\frac{1}{4}$-2 in. inclusive in rounds, and $\frac{1}{4}$-$1\frac{1}{2}$ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

COTTON WASTE—The following prices are in cents per pound:

	NEW YORK			
	Current	One Year Ago	Cleveland	Chicago
White	13.00	11.00–13.00	16.00	11.00 to 14.00
Colored mixed	9.00 to 12.00	8.50–12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	52.00	58.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$2.25	$2.25	$1.75
Philadelphia	2.00	2.00	1.75
Cleveland	2.50	2.50	2.75
Chicago	2.00	2.00	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.40	$3.40	$3.65
Cleveland	4.25	4.25	3.62
Chicago	5.00	5.00	4.50

COKE—The following are prices per net ton at ovens, Connellsville:

	Febr. 26	Feb. 19	Feb. 12	Feb. 5
Prompt furnace	$6.00	$6.00	$6.00	$6.00
Prompt foundry	7.00	7.00	7.00	7.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	375-lb. bag	2.50

LINSEED OIL—These prices are per gallon:

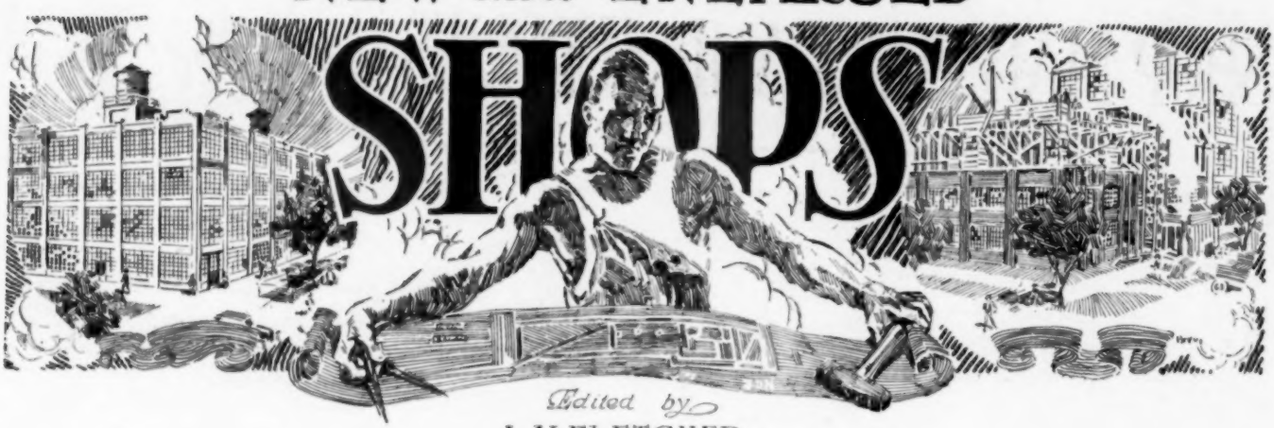
	New York		Chicago	
	Current	One Year Ago	Current	One Year Ago
Raw in barrels (5 bbl. lots)	$1.80	$1.50	$1.98	$1.66
5-gal. cans	2.00	1.65	2.23	1.86

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		One Year Ago		One Year Ago	
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13.00
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13.25
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50
5-lb. cans	18.50	20.00	15.00	16.50	18.50	15.00
1-lb. cans	20.50	22.00	16.00	17.50	20.50	16.00

500 lb. lots less 10% discount. 2000 lb. lots less 10–2½% discount.

NEW and ENLARGED



Edited by
L·V·FLETCHER

Machine Tools Wanted

The following concerns are in the market for machinery and machine tools.

Conn., Bantam—The Bantam Ball Bearing Co.—grinders, drill presses and millers.

Conn., Hartford—E. R. Seifort, 14 Sigourney St.—planer machine, shaper and miscellaneous small machine tool equipment.

Conn., New Haven—H. G. Thompson, Chapel and Mill Sts.—B. & S. No. 13 or similar universal cutter grinder.

Md., Baltimore—The Baltimore and Ohio R.R.—planers, shapers and lathes.

Md., Baltimore—H. E. Crook & Co., Inc., 28 Light St.—72 in. lathe and steam hammer, to have 1,500 lb. capacity.

Md., Baltimore—The Wizard Check Endorser and Printing Machine Co., 457 Calvert Bldg.—milling machine, drill press, metal stamping press, shapers and screw cutting machines.

Mass., Lynn—L. C. Soper, Hutchinson Lumber Wharf—wood cutter, 14 or 16 in. four sided machine (used).

N. J., Bayonne—The Electro Dynamic Co., Ave. A—1 planer and boring mills.

N. J., Camden—The Victor Talking Machine Co., Front and Cooper Sts.—woodworking machinery.

N. J., Keyport—The Aeromarine Plane and Motor Co., Locust St.—1 horizontal boring mill.

N. J., Perth Amboy—The Perth Amboy Dry Docks Co., Broad St.—1 turret lathe.

N. Y., Buffalo—F. G. Crane, 281 West Ferry St.—single spindle automatic screw machine to handle ⅜ to ⅞ in. stock and punch press. (used).

N. Y., Gouverneur—F. J. Love, c/o The Gouverneur Lumber Co., Hailesboro St.—woodworking equipment.

N. Y., Lawrence—E. Westervelt—garage equipment.

N. Y., New York (Borough of Bronx)—The Nathan Mfg. Co., 416 East 106th St.—machinery for the manufacture of steam specialties.

N. Y., New York (Borough of Brooklyn)—The Elsman Magneto Co., 32 33rd St.—machine tools.

N. Y., New York (Borough of Manhattan)—The Apollo Magneto Corp., 8th Ave. and 18th St.—one No. 10 double spindle belt driven internal grinder.

N. Y., New York (Borough of Manhattan)—The Cadillac Motors Co., 245 West 67th St.—lathes, millers and miscellaneous auto service equipment.

N. Y., New York (Borough of Manhattan)—The Fairbanks Co., Lafayette and Broome Sts.—Two No. 2 Kempsmith plane millers.

N. Y., New York (Borough of Manhattan)—Ford Bacon & Davis Co., Engrs., 115 Broadway, Account of Syracuse Washing Machine Co., Syracuse, N. Y.—
4 Porter cable finishing lathes.
5 Warner & Swasey Universal hand screw machines.
6 Cleveland automatics, Model A. and B.
2 Kempsmith plane millers.
3 Bilton No. 3½ gear cutters.
4 Barber Colman No. 12 gear hobbing machines.
1 Bilton No. 2½ gear miller.
4 No. D31 Fox multiple spindle drills.
3 Spindle Aveay No. 2.
1 Bilton Cam feed 4 spindle drill press.
2 26 in. Hoeffer back geared drill presses.
1 Barnes style B3 spindle drill press.
9 Canedy Otto No. 35 drill presses.
5 Edlund type 2-B sensitive drills.
2 Gardner Disc grinder No. 2
10 Blount No. 3 Emery stands.
5 New Britain No. 23 Automatics.
2 No. 34 New Britain automatics.
6 20 in. punch presses (E. W. Bliss).
11 No. 3 Gardner buffing jacks.
3 Rickert & Schaeffer ½ in. vertical tappers.
2 Rickert & Schaeffer ⅝ in. horizontal tappers.
1 Rickert & Schaeffer ¾ in. horizontal tappers.
2 6 x 6 14-in. blade Peerless hack saws.
1 Cochran-Bly No. 4 cold saw.
2 12 in. x 6 ft. Hendey Universal lathes.
2 14 in. x 8 ft. Hendey Universal lathes.
1 16 in. x 8 ft. Hendey Universal lathe.
1 18 in. x 10 ft. Hendey Universal lathe.
1 20 in. Hendey shaper.
1 24 in. Hoeffer back geared drill.
1 Brown & Sharpe No. 2 Universal miller.
1 Blount 13 in. x 8 ft. speed lathe.
1 Peerless 12 in. hack saw.
1 Blount No. 3 emery stand.
1 Blount No. 1 Emery stand.
1 Gisholt Universal tool grinder.
1 Wilmarth & Morman Universal drill grinder No. 1 DG.
1 No. 1 Norton grinder.
1 Dumore tool post grinder.
1 Wilmarth & Morman No. 78 surface grinder.
1 National acme No. 6 driller.
4 Morgan nailing machines No. 16.

N. Y., New York (Borough of Manhattan)—The Ingersoll Rand Co., 11 Broadway—2 Barrett horizontal boring mills (used).

N. Y., New York (Borough of Manhattan)—The Pace Mfg. Co., 123 Liberty St.—Two No. 4 V. & O. inclinable power presses.

N. Y., New York (Borough of Manhattan)—T. E. Ward, 30 Church St. —
One 30 x 18 in. between centers, oil country lathe with taper attachments.
One No. 3 Universal miller with gear drive, complete with index.
One 28 in. single pulley shaper.
One tool room lathe, single pulley with relieving attachment, taper attachments, and collets.
One small 10 to 12 in. lathe.
One pipe threading machine, up to 4 in.
One 2½ in. bolt cutter with taps, extra set of dies.
One 1,500 lb. steam hammer.
One 12 in. slotter for motor drive.
One steam driven air compressor, 400 to 500 cu.ft. at 110 lb.

N. Y., Niagara Falls—The Genl. Abrasive Co., Inc., College Ave., manufacturer of natural and artificial abrasives—rotary kiln such as is used by all cement mills (used).

N. Y., Schenectady—The General Electric Co., River Rd.—
Multiple spindle drill presses.
24 in. lathes.
20 to 24 in. shapers.
30 in. planer.
No. 2 or 3 miller.

N. Y., Syracuse—The Doyle & Wall Machine Tool Co., 322 Pearl St.—Face plate for Kempsmith No. 3.

N. Y., Syracuse—The Dyneto Electric Corp., 301 Wolf St.—sand blast equipment for iron castings, 50 to 200 lb.

Pa., Chambersburg—The T. B. Wood's Sons Co., 5th Ave.—pulley turning lathes for finishing pulleys up to 24 in. diameter. Steit type preferred (used).

Pa., Philadelphia—The Cambria Steel Co., Widener Bldg.—12 ft. boring mill.

Pa., Philadelphia—The T. P. Connard Co., 2 South 15th St.—14 in. Fay automatic, heavy duty Cincinnati drilling machine, 16 in. Le Blonde engine lathe, 16 in. Landis grinder (new or used).

Pa., Philadelphia—The O'Brien Mchy. Co., 119 North 3rd St.—large boring mill.

Pa., Pottstown—The Bethlehem Motors Corp.—2½ or 3 ft. radial drill.

Ga., Atlanta—The Corrugated Paper Products, Inc., L. J. Rosenberg, vice-pres., Majestic Hotel—lathes, planers, etc.

Ky., Covington—Huston, Stanwood & Gamble Co., 3rd and Philadelphia Sts.—21 in. back gear radial drill.

S. C., Gastonia—W. H. Adams—machinery for the manufacture of cotton.

Tenn., Memphis—The Reichman Crosby Co., 235 South Front St.—Burr keyseating milling machine.

Ia., Algona—W. J. Peck—20 to 24 in. lathe, a 14 x 16 in. shaping machine and a 20 to 24 in. drill press (used).

Ill., Chicago—The Federal Mchy. Sales Co., 12 North Jefferson St.—No. 1 Adams Farwell gear hobber (new or used).

Ill., Chicago—The Sellers Mfg. Co., Irving Pl.—one 48 in. engine lathe (new).

Ill., Chicago—The Standard Scale Co., 169 North May St.—a 24 to 36 in. throat power punch and 6 ft. bending rolls for ½ in. plate.

Mich., Cadillac—The Cadillac Metal Parts Co., c/o F. J. Deming—shears and small tools for the manufacture of tanks and fenders.

Mich., Detroit—The Detroit Gear and Machine Co., 129 Franklin St.—grinders, presses, millers, bolt cutter, lathes, drills,

arbor presses, miscellaneous small tools (new), for its No. 1 plant, and radial drills, grinders, millers, lathes, screw machines (new or used), for its No. 2 plant, also some general tool room equipment.

Mich., Detroit—The Eastern Eng. Co., Atwater St.—upsetters, headers, bulldozers, drop hammers, profile grinders, lathes, surface grinders, milling machines, (new or used).

Mich., Detroit—Morgan & Wright, Jefferson and Bellevue Aves.—900 tire machines, 1 h.p. motor to drive each individual machine.

Mich., Detroit—The Pharo Mfg. Co., 1336 Woodward Ave.—machine shop equipment.

Mich., Detroit—F. M. Roberts, c/o Olive Tool Wks., 97 East Congress St.—bench lathe, to take up to ¾ or ⅞ in. collets.

Mich., Detroit—C. E. Smith & Co., 708 Empire Bldg.—small tool equipment or repair work.

Mich., Detroit—F. W. Wiedmaier, 42 Campau Bldg.—electric crane and accessories.

Mich., Detroit—The Wilt Machine Co., 76 Bagley Ave.—One 22-24 in. drill press with back gear.

Mich., Flint—The Chevrolet Motor Car Co., West Kearsley St.—machinery for the manufacture of automobiles.

Mich., Highland Park—The Maxwell Motor Car Co., Oakland Ave.—general machine tools for the manufacture of automobiles.

Mich., Kalamazoo—The Central Mfg. Co., 310 East Ransom St.—machinery for the manufacture of rolls and screen plates for paper plants.

O., Canton—The Canton Drop Forge Co., 300-400 Odd Row Pl.—small planer.

O., Cleveland—The Biggs Watterson Co., 1235 West 9th St.—36 in. x 10 ft. double head planer (used).

O., Cleveland—The B. R. Deming Co., Bangor Bldg.—woodworking machinery, including belt sander and motor, chain mortiser and motor and a 15 hp. motor veneer press.

O., Cleveland—The Fisher Body Co., Oakland and Piquette Aves., Detroit, Mich.—mechanical and machine tool equipment to include a complete press.

O., Columbus—The Capital Die Tool and Machine Co., 619 North 4th St.—14 in. lathe and a surface grinding machine.

O., Columbus—The J. J. Reilly Mfg. Co., 302 North Ludlow St., manufacturer of steel automobile nuts—machine tools.

Wis., Green Bay—The Northwest Eng. Wks.—66 in. boring mill, a 48 in. gear hobber and a 22 in. gear planing machine. (new).

Wis., Kilbowin—The Fitzgerald Mfg. Co.—1 in. bolt spreading machine and a bulldozer.

Wis., Milwaukee—C. Burlock, 297 3rd St.—rubberizing machinery.

Wis., Milwaukee—City Water Dept.—drill presses and lathes.

Wis., Milwaukee—V. C. Lugner, 2508 Lisbon Ave.—two 18 ft. lathes and 3 small drill presses.

Wis., Milwaukee—The Magnetic Mfg. Co., 764 Windlake Ave.—one 34 in. swing radial drill.

Wis., Milwaukee—The Western Machine Co., 248 4th St.—lathes.

Wis., Sheboygan—The Levering Shoe Co., 222 Huron Ave.—machinery for the manufacture of shoes.

Wis., West Bend—The West Bend Lithia Co.—bottling and sealing machinery.

Mo., St. Louis—The Goodfellow Lumber Co., 5700 Natural Bridge Rd.—3 power saws, 2 planers and a belt conveyor.

Mo., St. Louis—M. Kausch, 1726 South 7th St.—repair shop equipment.

Cal., Burbank—The A. Burbank Co., Marsh Strong Bldg.—lathes, drills and small traveling crane.

Cal., Davis—The University of California, Berkeley,—equipment for handling and bottling milk, making butter, etc.

Ont., East Toronto—A. M. Slack, 86 Adelaide St.—heavy duty oil country lathe with taper attachment.

Ont., London—The Greene Swift Co.—machinery for the manufacture of clothing.

Ont., Peterboro—The Canadian Aladdin Co., Canadian Pacific Railway Bldg.—machinery for the manufacture of electric light bulbs.

Que., Montreal—Ames Holden McCready, Ltd., 1221 Mount Royal St., E.,—machinery for the manufacture of shoes.

N. S., Halifax—The Halifax Shipyards Co.—One 42 in. Bullard or similar, vertical boring mill.

Metal Working

NEW ENGLAND STATES

Conn., Bridgeport—The Board of Contract and Supply has awarded the contract for the construction of a 1 story, 146 x 200 ft. garage, on Madison Ave. Estimated cost, $150,000.

Conn., Bridgeport—The Bridgeport Castings Co., 250 North Ave., has awarded the contract for the construction of a 1 story, 134 x 198 ft. foundry, for the manufacture of castings. Estimated cost, $70,000.

Conn., Bridgeport—The Bridgeport Screw Co., Union Ave., manufacturer of screws, has awarded the contract for the construction of a 2 story, 60 x 150 ft. factory and a 2 story, 49 x 101 ft. addition to its factory, on Central Ave. Estimated cost, $100,000.

Conn., Hartford—Bd. Educ. South plans to build a 3 story high school, to include an office, class rooms, woodworking and machine shop, an electrical shop, gymnasium, lunch room, swimming pool, biological, physics and chemical laboratories, on Maple and Benton Sts. Estimated cost, $1,250,000. Whiton & McMahon, 36 Pearl St., Archt.

Conn., Hartford—E. R. Seifort, 14 Sigorney St., will incorporate with $30,000 capital and plans to build a factory for the manufacture of pipe bending and hair pin machines, also tobacco leaf sorter and an ice machine of 1 and 3 ton capacity.

Conn., Hartford—G. I. Whitehead, 1 Crescent St., has awarded the contract for the construction of a 2 story, 50 x 100 ft. garage, on New Britain Ave. Estimated cost, $35,000.

Conn., Meriden—The International Silver Co., 48 State St., manufacturer of silver goods, has awarded the contract for the construction of a 1 story, 42 x 130 ft. factory, on Brooks St. Estimated cost, $25,000.

Conn., Meriden—The Meriden Automobile Station Co., 41 West Main St., will soon award the contract for the construction of a 1 story, 70 x 80 ft. garage and service station. Estimated cost, $30,000. Orr & Del Grella, 956 Chapel St., New Haven. Archts.

Conn., New Britain—A. G. Hawker, 8 Elm St., has had plans prepared by Hine & Brumbaun, Archts., 242 Main St., for the construction of a 1 story, service station. Estimated cost between $25,000 and $30,000.

Conn., New Britain—M. Sicklick, 117 Willow St., plans to build a 1 story, 60 x 150 ft. garage, on Arch St. Estimated cost, $40,000. F. C. Walz, 348 Trumbull St., Hartford, Archt.

Conn., New Haven—J. V. Capuano, 65 Wallace St., plans to build a 1 story, 65 x 140 ft. garage, on Chapel St. Estimated cost, $30,000. H. S. Cannicci, 42 Church St., Archt.

Conn., New Haven—O. B. Horth & Co., 67 Franklin St., plans to build a 1 story, 40 x 110 ft. addition to its factory, for the manufacture of hardware. Estimated cost, $25,000.

Conn., Plainville—The Standard Steel and Roller Bearing Co. is having preliminary plans prepared for the construction of a 1 story factory. Estimated cost, $75,000.

Conn., South Manchester—E. J. Holl, Cheney Bldg., plans to build a 1 story, 80 x 106 ft. garage, at Keeney Court. Estimated cost, $25,000. A. E. Fiske, 709 Main St., Archt.

Conn., South Manchester—The Stephens Williams Co., 361 Center St., will soon award the contract for the construction of a 1 story, 80 x 195 ft. garage and show room, on Center St. Estimated cost, $60,000. A. E. Fiske, Johnson Bldg., South Manchester, Archt.

Conn., Stamford—The Yale & Towne Mfg. Co., 548 Pacific St., has awarded the contract for the construction of a 6 story, 50 x 202 ft. factory, for the manufacture of hardware goods. Estimated cost, $360,000.

Conn., West Hartford (Hartford P. O.)—M. Cohn, 63 Orange St., has awarded the contract for the construction of a 1 story, 52 x 195 ft. garage, on Prospect Ave. Estimated cost, $60,000.

Conn., Windsor—The General Electric Co., Lynn, has awarded the contract for the construction of a 3 story, 60 x 200 ft. factory, here. Estimated cost, $80,000.

Mass., Boston—The W. B. Rice Estate, c/o L. C. Greenleaf, Archt., 101 Tremont St., will soon award the contract for the construction of a 1 story garage and machine shop. Estimated cost, $150,000.

Mass., Cambridge—G. F. Snell, 96 Winthrop St., has had plans prepared by C. R. Greco, Archt., 8 Beacon St., Boston, for the construction of a 2 story, 62 x 70 ft. garage, on Boylston St. Estimated cost, $30,000.

Mass., Chelsea—F. A. Glazier, 107 Addison St., will soon award the contract for the construction of a 2 story, 100 x 120 ft. garage, on Pearl St. Estimated cost, $65,000. S. S. Eisenberg, Exchange Bldg., Archt.

Mass., Dorchester—The Mason Regulator Co., 1190 Adams St., has awarded the contract for the construction of a 2 story addition to its factory, for the manufacture of brass valves. Estimated cost, $30,000.

Mass., Roxbury—M. Nigroch, c/o J. A. Tuck, Archt., 34 School St., Boston, will build a 1 story, 110 x 115 ft. garage, on Walnut St. Estimated cost, $35,000.

Mass., Springfield—The Cheney Bigelow Wire Wks., Warwick Ave., has awarded the contract for the construction of a 2 story, 71 x 195 ft. and 48 x 271 ft. factory. Estimated cost, $200,000.

Mass., Worcester—J. A. Allen, c/o J. A. Jollette, Engr., 419 Grafton St., plans to build a 1 story, 65 x 125 ft. garage, on West Boylston St. Estimated cost, $25,000.

Mass., Worcester—The Worcester Buick Co., 803 Main St., plans to build a sales and service station, on Shrewsbury St. A. H. Bowditch, 44 Bromfield St., Boston, Archt.

R. I., Pawtucket—H. L. Murphy, Randall St and West Ave., plans to build a 1 story, 50 x 125 ft. garage. Estimated cost, $25,000.

R. I., Pawtucket—E. C. Wightman, 400 Broadway, plans to build a 1 story, 100 x 100 ft. garage, on Broadway and Lupine St. Estimated cost, $30,000.

R. I., Providence—D. Annotti, 568 Broadway, plans to build a 1 story, 60 x 150 ft. garage. Estimated cost, $25,000.

R. I., Providence—W. L. Wilcox, 322 Broadway, will soon award the contract for the construction of a 1 story, 60 x 160 ft. garage and service station, on Elmwood and Lenox Aves. Estimated cost, $35,000. T. C. Herrmann, 17 Exchange St., Archt.

MIDDLE ATLANTIC STATES

Md., Curtis Bay (Baltimore P. O.)—The Sterno Corp. chartered with $2,000,000 capital stock has acquired a 37 acre site and plans to build a factory for the manufacture of alcohol-burning heating devices for automobiles and boats.

N. J., Jersey City—The Continental Can Co. has awarded the contract for the construction of a 4 story factory. Estimated cost, $250,000.

N. J., Trenton—The Natl. Porcelain Co., Southard St., plans to build a 2 story, 50 x 72 ft. factory. Estimated cost, $20,000

R. G. Consolloy, Commonwealth Bldg., Archt.

N. J., Trenton—The Niedt Ertel Motor Co., 350 South Broad St., plans to build a 3 story, 75 x 100 ft. garage and showroom. Estimated cost, $74,000. R. G. Consolloy, 311 Commonwealth Bldg., Archt.

N. Y., Buffalo—The Buffalo Hardware and Foundry Co., 747 Hertel Ave., plans to build an addition to its plant. Estimated cost, $16,000.

N. Y., Buffalo—The Jacob Dold Packing Co., 745 William St., plans to build a 2 story repair shop, at 341 Howard St. Estimated cost, $35,000.

N. Y., Lockport—The Covert Gear Co., Grand St., has awarded the contract for the construction of a 3 story addition to its plant. Estimated cost, $250,000.

N. Y., New York (Borough of Manhattan)—I. Dietelbaum, c/o S. B. Eisendrath, Archt., 18 East 41st St., will build a 1 story garage at 513-15 West 130th St. Estimated cost, $35,000.

N. Y., New York (Borough of Manhattan)—A. Klinghoffer, 259 West 30th St., is having plans prepared by L. A. Sheinart, Engr., 194 Bowery Pl., for the construction of a 2 story, 65 x 100 ft. garage, at 1-9 Old Broadway. Estimated cost, $75,000.

N. Y., New York (Borough of Queens)—The New York and Queens Electric Light Power Co., Long Island City, will soon award the contract for the construction of a 3 story, 35 x 100 ft. garage, on Hamilton Ave. Estimated cost, $25,000.

N. Y., Rochester—The Northwest Foundries, Inc., Curlew and Villa Sts., is having plans prepared by J. H. Oberlies, Archt., for the construction of a 2 story, 197 x 250 ft foundry, at Villa and Valentine Sts. Estimated cost, between $125,000 and $150,000.

Pa., Philadelphia — The Hotel Brotherhood U. S. A., c/o A. C. Borzner, Archt., 717 Walnut St., has awarded the contract for the construction of a 2 story, 67 x 120 ft. garage and hall, on Bainbridge and 16th Sts. Estimated cost, $32,000.

Pa., Wilkes-Barre—The Sheldon Axle Co., 221 Conyngham St., has awarded the contract for the construction of a 1 story, 100 x 220 ft. assembling plant, on Beaumont St. Estimated cost, $70,000.

Pa., Wilkes-Barre—The Vulcan Iron Wks., 730 South Main St., is having plans prepared by E. D. Rinehimer, Archt., Carlisle St., for the construction of a 90 x 200 ft. locomotive shop, on Hazel Ave. Estimated cost, $130,000.

SOUTHERN STATES

S. C., Greenville — The Greenville Iron Wks. plans to build a 50 x 120 ft. machine shop and a 54 x 130 ft. foundry. J. E. Sirrine, Greenville, Archt.

MIDDLE WEST

Ill., Chicago—The Acme Steel Goods Co., 2834 Archer Ave., has awarded the contract for the construction of a 1 story, 150 x 600 ft. building to house twenty 10 in. cold roll mills and corresponding ovens and finishing machinery.

Ill., Chicago—The Concrete Steel Co., 53 West Jackson St., has awarded the contract for the construction of a 1 story, 80 x 100 ft. factory, on Central Park Ave. and 31st St. Estimated cost, $25,000.

Ill., Elgin—The Elgin Natl. Watch Co., 10 South Wabash Ave., Chicago, is having plans prepared by Postle & Fischer, Archts., 140 South Dearborn St., for the construction of a plant, to include several 4 story buildings. Estimated cost, $1,000,000.

Ind., Hammond—The La Salle Steel Co., 2243 South Halsted St., plans to build an 800,000 sq.ft. steel fabricating plant, to consist of 3 buildings. Estimated cost, $1,000,000.

Ind., Indianapolis—The Acme Aluminum and Brass Wks., 420 South Harding St., will soon award the contract for the construction of a factory, to have 50,000 sq. ft. floor space. Estimate cost, $70,000.

Ind., Kendalville—The Kendalville Foundry Co. will soon award the contract for the construction of a 1 story foundry. Estimated cost, $30,000.

Ind., Kokomo—The Dennis White Automobile Co. is having plans prepared by McGraw & Stevenson, Archts., 320 Kokomo Trust and Savings Bldg., for the construction of a 3 story, 78 x 144 ft. garage and salesroom, on Buckeye and Jackson Sts.

Mich., Detroit—The Pharo Mfg. Co., 1336 Woodward Ave., will soon award the contract for the construction of a 1 story, 60 x 150 ft. factory, for the manufacture of automobile truck parts. Estimated cost, $30,000. Brown & Preston, 406 Empire Bldg., Archts.

Mich., Detroit—C. E. Smith & Co., 708 Empire Bldg., has had plans prepared by E. R. Dunlap, Archt., 709 Hammond Bldg., for the construction of a 2 story, 100 x 200 ft. garage and sales room, on John R. St. and Edmund Pl. Estimated cost, $60,000.

O., Cincinnati — The Fischer Specialty Machinery Co., 2076 Reading Rd., plans to build a 100 x 200 ft. factory, on McMillan St. Estimated cost, $100,000.

O., Cincinnati — The Willard Machine Tool Co., 3d and Madison Sts., has awarded the contract for the construction of a 1 story factory. Estimated cost, $9,000.

O., Cleveland—The Amer. Steel and Wire Co., Western Reserve Bldg., will build a 1 story, 33 x 38 ft. addition to its factory on East 67th St. Estimated cost, $5,000.

O., Cleveland—The Browning Co., East 162d St. and Waterloo Rd., manufacturer of cranes and hoisting machinery, has awarded the contract for the construction of a 1 story factory and addition to its garage. Estimated cost, $15,000.

O., Cleveland—The Buckeye Brass Co., 6410 Hawthorne Ave., will soon award the contract for the construction of a 1 story, 30 x 110 ft. foundry and a 75 x 75 ft. furnace room on Ashland Rd. Estimated cost, $60,000. A. Sogg, 319 Hippodrome Bldg., Archt. Noted Feb. 19.

O., Cleveland—The Fisher Body Co., Oakland and Piquette Aves., Detroit, Mich., will soon award the contract for the construction of a 7 story, 120 x 1300 ft. factory on Coit Rd., here, for the manufacture of automobile bodies.

O., Cleveland — F. K. Gatch, Guardian Bldg., plans to construct a 1 story, 140 x 200 ft. commercial building and garage on Euclid Ave. near East 65th St. Estimated cost, $100,000.

O., Cleveland—The Jones Gear Co., Way Side Rd., plans to build a 1 story factory. Estimated cost, $75,000. F. H. Jones, Pres.

O., Cleveland—The Natl. Bronze and Aluminum Co., 2539 East 79th St., has awarded the contract for the construction of a 1 story, 150 x 201 ft. factory, at 8904 Laisy Ave. Estimated cost, $60,000. Noted Feb. 19.

O., Cleveland—The Otis Steel Co., Leader-News Bldg., has awarded the contract for the construction of a plant on Jennings Rd. to include a 2 story, 75 x 400 ft., a 1 story, 90 x 400 ft., a 1 story, 40 x 400 ft. and a 1 story, 80 x 400 ft. buildings. Estimated cost, $500,000.

O., Cleveland—The L. Sands Co., 5407 Sweeney Ave., manufacturer of water heaters, has awarded the contract for the construction of a 2 story, 60 x 80 ft. addition to its factory, on East 55th St. and Sweeney Ave. Estimated cost, $50,000.

O., Cleveland—The W. W. Sly Mfg. Co., West 47th St. and Train Ave., manufacturer of foundry supplies, has awarded the contract for the construction of a 2 story, 115 x 220 ft. erecting shop. Estimated cost, $60,000.

O., Cleveland—The J. T. Tractor Co., Bangor Bldg., has awarded the contract for the construction of a 1 story, 58 x 125 ft. factory, on Fairfield Ave. Estimated cost, $60,000. A. O'Brien, Mgr.

O., Columbus—The J. Schonthal Iron Co., West Buttles Ave., has awarded the contract for the construction of a 1 story, 30 x 70 ft. factory and office building. Estimated cost, $22,000.

O., Dayton — The Computing Scale Co., 448 Huffman Ave., has awarded the contract for the construction of a 5 story, 50 x75 ft. factory, for the manufacture of scales. Estimated cost, $100,000.

O., Dayton—The Dimler Himes Tool Co., manufacturer of tools, dies, and jigs, has purchased a 2 acre site on 3d and Minerva Aves., and plans to construct several buildings. W. J. Dimler, Pres.

O., Dayton—The Dodge Bros. Automobile Sales Co. has awarded the contract for the construction of a 3 story, 60 x 100 ft. garage and sales station, on 1st and Jefferson Sts. Estimated cost, $80,000.

O., Dayton—The Natl. Cash Register Co., Main and K Sts., has awarded the contract for the construction of a 2 story, 60 x 350 ft. factory, on South Main St. Estimated cost, $80,000.

O., Norwood (Cincinnati P. O.)—The Allis Chalmers Co., Forest Ave., has awarded the contract for the construction of a 3 story factory, for the manufacture of power machinery. Estimated cost, $75,000.

O., Springfield—The Westcott Motor Car Co., Warden and Spring Sts., has awarded the contract for the construction of a 2 story, 30 x 70 ft. factory, on Lagonda St. Estimated cost, $35,000.

Wis., Beloit—The Gardner Machine Co., South Beloit, will build an addition to its plant. Estimated cost, $100,000. L. Waldo Thompson, Pres.

Wis., Madison—The Gisholt Machine Co., 1315 East Washington Ave., has awarded the contract for the construction of a 1 story, 100 x 200 ft. addition to its foundry. Estimated cost, $80,000.

Wis., Madison—J. G. D. Mack, State Cr. Engr., will soon award the contract for the construction of a 1 and 2 story, 52 x 72 ft. shop at the power plant, at the State Capitol. A. Peabody, Madison, State Archt.

Wis., Manitowic — The Wisconsin Aluminum Products Co., 16th and Franklin Sts., plans to build a 4 story, 60 x 250 ft. factory, on 8th St., for the manufacture of aluminum goods. Estimated cost, $250,000.

Wis., Milwaukee—Doelger & Kirsten, 505 Cedar St., have awarded the contract for the construction of a 1 story, 90 x 200 ft. machine shop, on 30th St. Estimated cost, $75,000.

Wis., Milwaukee—J. Heil, 26th and Montana Aves., plans to build a 4 story, 100 x 125 ft. automobile sales station, on Broadway. Estimated cost, $100,000. Klug & Smith, 40 Mack Bldg., Archts. and Engrs.

Wis., Milwaukee—The Milwaukee Printers Roller Co., 214 Greenbush St., is having plans prepared by C. J. Keller & Son, Archts., Majestic Bldg., for the construction of a 1 or 3 story, 60 x 100 ft. addition to its factory.

Wis., Milwaukee—The Osmond Motor Car Co., 503 Broadway, plans to build a 3 or 4 story automobile service station. Estimated cost, $100,000.

Wis., Milwaukee—The Pelton Steel Co., 672 Kinnickinnie Ave., has awarded the contract for the construction of a 1 story 60 x 100 ft. addition to its foundry. Estimated cost, $50,000.

Wis., Milwaukee—The R. & S. Realty Co., 409 Railway Exchange Bldg., has awarded the contract for the construction of a 1 story, 157 x 200 ft. garage, on Prospect Ave. Estimated cost, $80,000.

Wis., Milwaukee—The T. L. Smith Co., 32nd and Hadley Sts., manufacturer of concrete machinery, has awarded the contract for the construction of a 1 story, 50 x 270 ft. erecting shop, on 32nd St. Estimated cost, $75,000.

Wis., Milwaukee—The Wisconsin State Rubber Co., 181 4th St., will soon award the contract for the construction of a 3 story, 50 x 100 ft. automobile sales building and service station. Estimated cost, $80,000. M. Tuligren & Son, 425 East Water St., Archt.

WEST OF THE MISSISSIPPI

Idaho, Payette—The Bldg. Com. of Washoo Lodge No. 28, A. F. & A. M., plans to build a 1 story, 60 x 140 ft. garage. Estimated cost, $50,000. D. C. Chase, Chn.

Ia., Davenport—The H. J. Frank Fdry. and Machine Co., 2nd St., has awarded the contract for the construction of a 1 story, 80 x 100 ft. foundry, at 1768 West 2nd St. Estimated cost, $26,000

Ia., Fairfield—Bd. Educ. plans to build a 2 story, 68 x 118 ft. junior high school, to include a manual training department, gymnasium and domestic science department. Estimated cost, $150,000. W. Gordon, 317 Hubbell Bldg., Des Moines, Archt.

Kan., Salina—The Standard Oil Co. of Kansas, Neodesha, plans to build a garage, office building, 2 service stations and a warehouse, on the site of its present building here. Estimated cost, $175,000.

Mo., Joplin—The Sorber Kuhn Automobile Co., 512 Joplin St., has awarded the contract for the construction of a 1 story, 75 x 120 ft. factory, at 501-505 Wall St. Estimated cost, $30,000.

Mo., St. Louis—M. Kausch, 1726 South 7th St., hs awarded the contract for the construction of a 1 story, 50 x 75 't. garage and repair shop, at 1800-4 South 7th St. Estimated cost, $8,000.

Neb., Aurora — The Sandin Automobile Co. is having plans prepared by Grabe & Helleberg, Archts., Columbus, for the construction of a 1 story, 120 x 211 ft. garage. Estimated cost, $60,000.

Neb., Columbus—The Gottberg Automobile Co. is having plans prepared by Grabe & Helleberg, Archts., Columbus, for the construction of a 2 story, 90 x 132 ft. garage. Estimated cost, $80,000.

Neb., Omaha — Bd. Educ., c/o W. E. Bourke, City Hall, is having plans prepared by F. W. and E. B. Clark, Archts., 683 Paxton Bldg., for the construction of two 1 story, 50 x 100 ft. shops, a 75 x 75 ft. gymnasium and a 2 story, 72 x 318 ft. mechanics building, in connection with a technical and commercial high school, on 33d and Burt Sts. Total estimated cost, $1,500,000.

Okla., Sand Springs — The Tulsa Stove and Foundry Co. plans to build a 1 story, 72 x 320 ft. foundry. Estimated cost, $50,000.

Okla., Tulsa—The Universal Motor Car Co., Cameron and North Main Sts., plans to build a 2 story, 140 x 200 ft. automobile shop on 2d and Frankfort Sts. Estimated cost, $150,000.

Tex., Houston — The Japanese Cotton Trading Co., Grain and Cotton Exchange Bldg., Ft. Worth, has purchased a site here along the tracks of the Houston Belt R. R. and plans to build a 1 story, 50,000 bale compress and warehouse. Estimated cost, $300,000.

Tex., Houston—The Lone Star Steel and Bridge Co., 214 Carter Bldg., plans to build fabricating plant, on Harrisburg Blvd. along tracks of the Municipal R. R. G. E. Cole, Pres.

WESTERN STATES

Cal., Burbank — The A. Burbank Motor Co., Marsh Strong Bldg., Los Angeles, is having plans prepared by F. R. Dorn, Archt., Marsh Strong Bldg., Los Angeles, for the construction of three 1 story, 50 x 165 ft. factories, for the manufacture of tractors and automobiles. Estimated cost, $125,000.

Cal., Santa Ana—The Trustees of the Union High School Dist. will soon award the contract for the construction of a school, to include a 64 x 154 ft. auditorium and class room building, 26 x 65 ft. gymnasium, a 45 x 64 ft. shop, also alterations to present buildings. Estimated cost, $110,000. N. F. Marsh, Broadway Central Bldg., Los Angeles, Archt.

Wash., Seattle—The Moran Mfg. Co., 1220 1st Ave., S., plans to build a 2 story, 60 x 120 ft. addition to its pump manufacturing plant, on 1st Ave., S., and Forest St. Estimated cost, $25,000. Rietze, Storey & Duffy, Seaboard Bldg., Engrs.

Wash., Spokane — City is having plans prepared by A. Riggs, Archt., Peyton Bldg., for the construction of a garage. Estimated cost, $35,000.

CANADA

Ont., London—The McClary Mfg. Co., 333-343 Wellington St., manufacturer of gas ranges, will build a 2 story, 85 x 185 ft. factory, on Trafalgar St. Estimated cost, $60,000. J. M. Moore, 423 Richmond St., Archt.

Ont., Peterboro — The Canadian Aladdin Co., Canadian Pacific Railway Bldg., has awarded the contract for the construction of a 3 story, 60 x 80 ft. factory, for the manufacture of electric lamps. Estimated cost, $125,000.

Que., Quebec — P. L. Lortie, Ltd., 138 Bridge St., plans to build a 2 story, 100 x 160 ft. garage on St. Paul St. Estimated cost, $80,000. A. Bastien, 138 St. Anne St., Archt.

General Manufacturing

NEW ENGLAND STATES

Conn., Westbrook—The Knothe Bros. Co., 124 5th Ave., New York City, plans to build a 2 story, 54 x 150 ft. factory here for the manufacture of suspenders. Estimated cost, $120,000. Fletcher Thompson, Inc., 1089 Broad St., Bridgeport, Conn., Archts.

Mass., Dedham—The Dedham Finishing Co. will soon award the contract for the construction of a 2 story, 45 x 140 ft. factory on Maverick St. Estimated cost, $40,000. Haven & Crosby, 40 Court St., Boston, Archts.

Mass., Everett — The Bunker Hill Shoe Co., Broadway, plans to build a 4 story, 90 x 100 ft. factory, for the manufacture of shoes. Estimated cost, $90,000. Burk & Bottomley, 34 School St., Boston, Archts.

Mass., Middleboro — The Nemasket Worsted Mills Co. will soon award the contract for the construction of a 1 story, 70 x 140 ft. and a 1 story, 36 x 50 ft. weave shed and a 25 x 50 ft. office. Estimated cost, $50,000. C. T. Main, 201 Devonshire St., Boston, Archt.

Mass., Quincy (Boston P. O.)—The Bethlehem Shipbuilding Corp. will soon award the contract for the construction of a 3 story, 50 x 220 ft. shop, along the Fore River. Estimated cost, $75,000.

Mass., West Springfield (Springfield P. O.)—The Container Realty Co., Ft. Wayne, Ind., has awarded the contract for the construction of a 2 story factory, on Sackett Rd., for the manufacture of paper containers. Estimated cost, $75,000.

R. I., West Barrington—The Rhode Island Lace Wks. has awarded the contract for the construction of a 2 story, 50 x 390 ft. addition to its factory. Estimated cost, $125,000.

Vt., St. Johnsburg—The A. H. McLeod Milling Co. is having plans prepared by G. W. & H. A. Lane, Archt., Exeter, N. H., for the construction of an addition to its flour and feed plant. Estimated cost, $50,000.

SOUTHERN STATES

Ga., Athens—A. D. Atkinson and V. A. Reaves will build a 2 story broom factory. Estimated cost, $5,000.

Ga., Athens—The J. Costa Co. has awarded the contract for the construction of a 3 story, 50 x 100 ft. factory, for the the manufacture of ice cream. Estimated cost, $60,000.

Ga., Griffin—The Griffin Mfg. Co. has awarded the contract for the construction of a 2 story, 100 x 220 ft. and a 2 story, 75 x 170 ft. mill for the manufacture of textile goods. Total estimated cost, $150,000.

N. C., Belmont—The Linford Mills, Inc., plan to build a yarn mill. Estimated cost, $500,000.

N. C., Belmont—The Perfection Spinning Mills plan to build a yarn mill.

N. C., Gastonia—The Adams-Spencer Spinning Mills, Inc., plan to build a yarn mill. Estimated cost, $75,000.

N. C., Gastonia—The Priscilla Spinning Co. plan to build a yarn mill. Estimated cost, $500,000.

N. C., Spindale—K. S. Tanner plans to build a 2 story yarn mill and a 2 story cotton mill. Total estimated cost, $125,000. J. E. Sirrine, Greenville, S. C., Archt.

N. C., Troy—The Aileen Cotton Mills plan to build a cotton mill. Estimated cost, $200,000.

S. C., Gaffney—W. C. Hamrick plans to build a cotton weaving mill. Estimated cost, $500,000. J. E. Sirrine, Greenville, Engr.

S. C., Gastonia—W. H. Adams and others have formed a company with $1,500,000 capital stock and plans to build a cotton mill along the tracks of the Piedmont & Northern R. R.

S. C., Walhalla—The Keowee Yarn Mills plans to build an addition to its mill. Estimated cost, $200,000. J. E. Sirrine, Greenville, Archt.

MIDDLE ATLANTIC STATES

N. J., Trenton — The Blakely Laundry Co., 11 South Warren St., has awarded the contract for the construction of a 1 story, 125 x 200 ft. laundry, on North Montgomery St. Estimated cost, $125,000.

N. Y., Amsterdam — The Shuttleworth Bros. Co. has awarded the contract for the construction of a 6 story, 62 x 300 ft. factory, for the manufacture of carpets and rugs. Estimated cost, $400,000.

N. Y., Binghamton — The Dunn & McCarthy Shoe Co., 30 Charlotte St., plans to build an addition to its factory. Estimated cost, $50,000.

N. Y., Buffalo—The Donner, Union Coke Corp., 105 Beacon St., plans to build a service station and first aid station at 475 Abbott Rd. Estimated cost, $25,000.

N. Y., College Point (Flushing P. O.)—The American Hard Rubber Co. will build a 120 x 130 ft. factory.

N. Y., New York (Borough of Queens)—H. A. Mallison, Long Island City, c/o Lockwood Greene Co., Archts., 101 Park Ave., New York City, will soon award the contract for the construction of a 2 story, 125 x 207 ft. factory, for the manufacture of silk. Estimated cost, $225,000.

N. Y., Rochester—The Virginia Carolina Chemical Co. plans to build a factory on Lyell Ave. and Barge Canal, for the manufacture of fertilizers. Estimated cost, $500,000.

N. Y., Woodhaven—The Merritt Hosiery Co., c/o Block & Hesse, Engrs., 18 East 41st St., New York City, has awarded the contract for the construction of a 4 story, 60 x 180 ft. factory, on 104th St. Noted Feb. 26.

Pa., Doranceton (Wilkes-Barre P. O.)—The Duplan Silk Corp. is having plans prepared by G. Welch, Archt., Coal Exchange Bldg., Wilkes-Barre, for the construction of a 3 story, 100 x 300 ft. addition to its silk mill. Estimated cost, $400,000.

Pa., Kingston—The Kingston Silk Co. plans to build a 2 story, 50 x 100 ft. silk mill, on Market St. Estimated cost, $65,000.

Pa., Philadelphia—Friedberger & Arson, 18th and Courtland Sts., manufacturer of braids, has awarded the contract for the construction of a 3 story, 74 x 100 ft. addition to its factory, on Courtlan dand Gratz Sts. Estimated cost, $100,000.

Pa., Philadelphia — The Standard Crown Co., Hope and Palmer Sts., manufacturer of bottles and stoppers, will soon award the contract for the construction of a 1 story, 62 x 200 ft. and 16 x 20 ft. factory. Estimated cost, $35,000. Mills & Van Kirk, Harrison Bldg., Archts. and Engrs.

Pa., Wilkes-Barre — The Sheldon Axle Co., 221 Conyngham Ave., plans to build a 3 story, 100 x 200 ft. heat treating plant, on Beaumont St. Estimated cost, $200,000.

MIDDLE WEST

Ill., Chicago—The Foell Supply Co., 331 West 22d Pl., has acquired 37,000 sq. ft. of land on 47th St. near Kedzie Ave. and plans to build a 3 story meat packing plant. Estimated cost, $200,000.

Ill., Chicago—The E. O. Reed Co., Inc., 2956 North Leavitt St., has purchased 28,000 sq.ft. of land on Fletcher St., along the tracks of the St. Paul R.R., and plans to build a factory for the manufacture of candy. Estimated cost, $175,000.

Ind., Evansville—The Evansville Paper Box Mfg. Co., Main and Water Sts., plans to build a 2 story, 75 x 150 ft. factory. Estimated cost, $35,000.

Ind., Indianapolis—The Van Briggle Chemical Co. will soon award the contract for the construction of a factory, on 16th St. and Capitol Ave. Estimated cost, $125,000. C. E. Bacon, 1110 Odd Fellows' Bldg., Archt.

Mich., Charlotte — The Charlotte Chair Co. is having plans prepared by G. T. Appleyard, Archt., 429 Houseman Bldg., for the construction of a 3 story, 48 x 95 ft. factory, for the manufacture of furniture. Estimated cost, $30,000.

Mich., Detroit—The Detroit Belt Lacer Co., 27 A St., will soon award the contract for the construction of a 2 story, 60 x 100 ft. factory. Estimated cost, $35,000. L. Scisorek, 225 Farwell Bldg., Archt.

Mich., Saginaw — The Lufkin Rule Co., Hess Ave., has awarded the contract for the construction of a 1 story, 115 x 219 ft. factory, on Hess Ave. and Prescott St., for the manufacture of tapes and rulers. Estimated cost, $100,000.

O., Akron — The Telling, Belle, Vernon Co., 3700 Cedar Ave., Cleveland, manufacturer of ice cream, has awarded the contract for the construction of a 1 story, 50 x 92 ft. addition to its factory, an 18 x 40 ft. garage, and a 50 x 50 ft. salt house, on East Exchange St. Estimated cost, $20,000.

O., Cleveland — The United States Gypsum Co., 1714 Merwin Ave., plans to build a 2 story factory. Estimated cost, $100,000. P. A. Ryder, Supt.

O., Columbus — The German American Publishing Co., 201 Hartman Bldg., has awarded the contract for the construction of a 5 story, 50 x 62 ft. printing plant, on East Main St. Estimated cost, $55,000.

O., Columbus—The Ohio Wax Paper and Printing Co., 22nd and Frebis Sts., has awarded the contract for the construction of a 1 story, 111 x 157 ft. factory, on Hanford St. Estimated cost, $45,000.

O., West Park—W. E. Asplin, Lorain and Harrington Aves., has awarded the contract for the construction of a 1 story, 40 x 80 ft. factory, for the manufacture of baskets, at 15101 Lorain Ave. Estimated cost, $6,000.

Wis., Milwaukee—The Columbia Realty Co., 236 Broadway, will soon award the contract for the construcion of a 1 story, 110 x 225 ft. factory, on 33rd St., for the manufacture of knit goods. Estimated cost, $100,000. Leiser & Holst, Brunder Bldg., Archts.

Wis., Sheboygan — The Armour Leather Co., 175 North Franklin St., Chicago, Ill., has awarded the contract for the construction of a tannery, here. Estimated cost, $750,000.

Wis., Sheboygan—The Levering Shoe Co., 222 Huron Ave., plans to build a 3 story, 50 x 70 ft. shoe factory, on North 8th St. Estimated cost, $40,000. C. Levering, Mgr.

Wis., West Bend—The Schmidt & Storck Wagon Co., Mill St., is having plans prepared by Buemming & Guth, Archts., 521 Jackson St., Milwaukee, for the construction of a 1 story, 100 x 300 ft. factory.

Wis., West Bend—The West Bend Lithia Co. is having plans prepared by The Federal Eng. Co., Engrs. and Archts., Stephenson Bldg., Milwaukee, for the construction of a 2 story, 35 x 80 ft. water bottling plant.

WEST OF THE MISSISSIPPI

Ia., Cedar Rapids—The Pennick & Ford Co., Inc., canners, will reconstruct buildings destroyed by explosion; also construct several new buildings. Estimated cost, $5,000,000.

Kan., Hutchinson—The R. Seibold Candy Co. has awarded the contract for the construction of a 4 story, 42 x 113 ft. factory, for the manufacture of candy. Estimated cost, $55,000.

Kan., Topeka — The Beatrice Creamery Co., 2d and Polk Sts., is having plans prepared for the construction of a 3 story addition to its creamery. Estimated cost, $100,000.

Mo., St. Louis—The Goodfellow Lumber Co., 5700 Natural Bridge Rd., has awarded the contract for the construction of a 1 story, 60 x 100 ft. planing mill, at 5778 Natural Bridge Rd. Estimated cost, $7,000.

Okla., Oklahoma City — The New State Shirt and Overall Co. plans to build a 3 story, 80 x 190 ft. factory. Estimated cost, $140,000. C. P. Nieder, Archt.

Okla., Tulsa—The Robinson Packer Co., 226 East 3d St., plans to build a 2 story, 90 x 130 ft. factory, at 209-17 North Main St., for the manufacture of oil well supplies. Estimated cost, $100,000. O. K. Eysenback, Pres.

WESTERN STATES

Cal., Davis — The University of California, Berkeley, is having plans prepared by W. C. Hays, Archt., 1st Natl. Bank Bldg., San Francisco, for the construction of a 1 story creamery, on the university farm, here. Estimated cost, $100,000.

Cal., Los Angeles—The Eno Tire and Rubber Co., 1026 South Los Angeles St., has purchased a site on Slanson Ave. and plans to build a 1 story, 188 x 195 ft. factory.

Cal., Los Angeles—The Los Angeles Soap Co., 633 East 1st St., has awarded the contract for the construction of a 1 story, 45 x 125 ft. factory, on 1st and Banning Sts. Estimated cost, $24,000.

Ore., Klamath Falls—The Saddle Mountain Lumber Co. is having plans prepared for the construction of a 1 story sawmill, to have 100,000 ft. daily capacity. Estimated cost, $10,000. H. H. Edmonds, Mgr.

CANADA

Ont., Ottawa—The Dominion Loose Leaf Co., Wellington St., plans to build a 4 story, 66 x 200 ft. factory and printing plant, on Albert St. Estimated cost, $400,000. Richards & Abra, 126 Sparks St., Archts.

Que., Montreal—Ames Holden McCready, Ltd., 1221 Mount Royal St., E., has awarded the contract for the construction of a 2 story, 20 x 22 ft. factory, on Messier St., for the manufacture of shoes. Estimated cost, $12,000.

Que., Montreal — The Holland Varnish Co., Ltd., Park and Atlantic Aves., is building a 4 story, 30 x 80 ft. factory. Estimated cost, $85,000.

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